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ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series)	N84-28726 - N84-31084
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IAA (A-10000 Series)	A84-39763 - A84-42707
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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 180)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in October 1984 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 546 reports, journal articles, and other documents originally announced in October 1984 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Six indexes -- subject, personal author, corporate source, contract number, report number, and accession number -- are included.

An annual cumulative index will be published.

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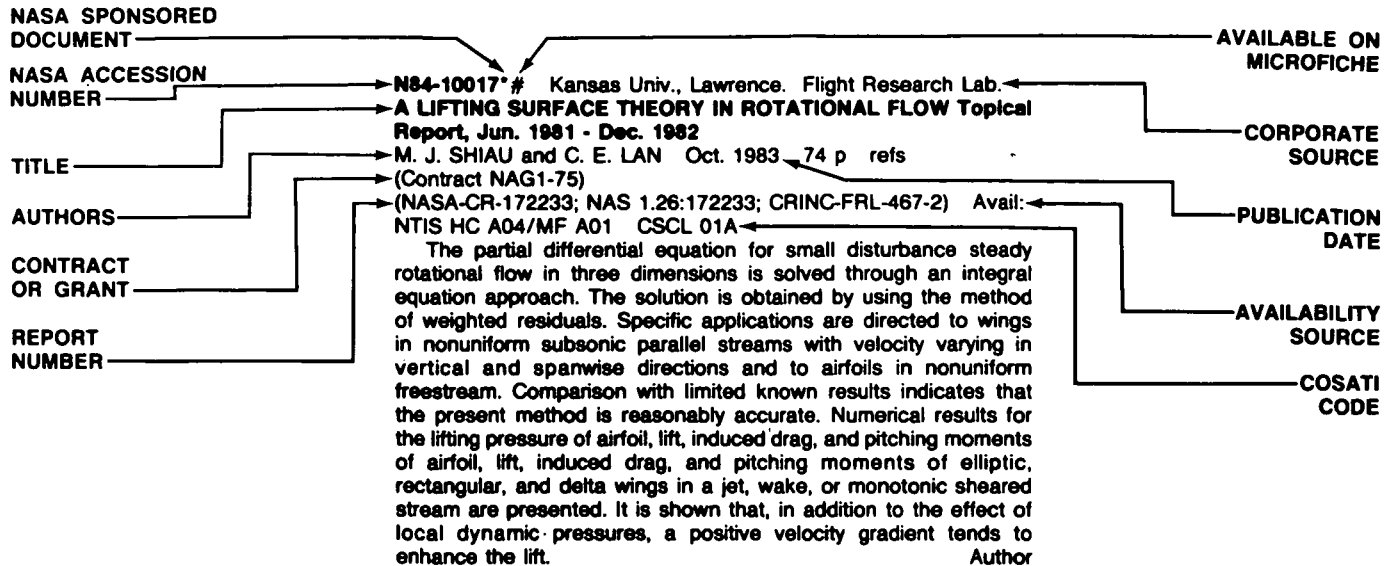
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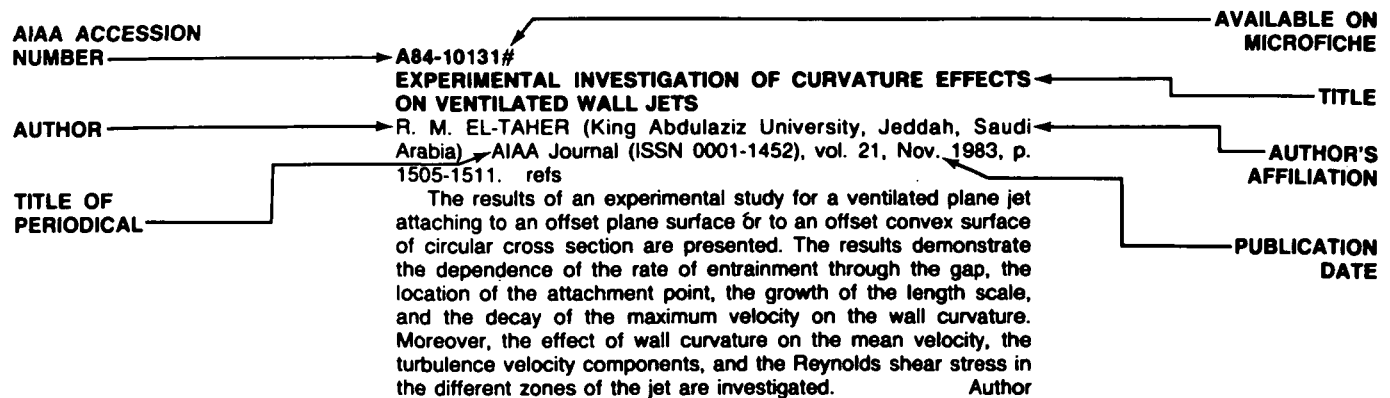
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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 180)

NOVEMBER 1984

01

AERONAUTICS (GENERAL)

A84-40137

FUNDAMENTALS OF AVIATION (2ND REVISED AND ENLARGED EDITION) [OSNOVY AVIATSII /2ND REVISED AND ENLARGED EDITION/]

G. A. NIKITIN and E. A. BAKANOV Moscow, Izdatel'stvo Transport, 1984, 264 p. In Russian. refs

The history of civil aviation and the general aerodynamic principles of fixed wing and rotary wing flight are treated. Attention is given to civilian aircraft configurations with respect to the structure of wings and their lift augmentation devices, tail assemblies, fuselages, undercarriages, control systems, propellers and helicopter rotors. Basic theory and technology incorporated in the design of reciprocating piston and reactive aircraft engines are also discussed, with emphasis on fuel injection, lubrication and hydraulic systems. High-altitude deicing, radio, and electronic systems are described in detail, and a series of diagrams of aircraft systems and their subsystems is provided. I.H.

A84-41066

THE PILOT'S ROLE IN THE AUTOMATED ATC SYSTEM

W. B. COTTON (Air Line Pilots Association International, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 153-155.

A semiautomated system of distributed monitoring of air traffic is discussed. The system will augment the responsibilities of the pilot in monitoring air traffic with the help of an onboard cockpit display of traffic information. The traffic display and Mode S data communications link will permit the pilot to react quickly within the organizational plan of the ATC system. The benefits resulting from greater pilot participation in the control loop include greater safety for passengers and greater flexibility for ground-based air traffic controllers. I.H.

A84-41246

TRANSPORT AIRCRAFT - PROGRESS AND PROBLEMS. I - FROM FLYING BOATS TO JETS

J. G. BORGER Exxon Air World, vol. 36, no. 1, 1984, p. 12-15, 30.

The various commercial aircraft and the technological changes incorporated in the past half-century are surveyed. Commercial passenger transport is asserted to have succeeded because of increased wing loading, the production of multi-engined aircraft, engine configurations that were aerodynamically optimized, upgraded fuel quality and structural improvements. Features of the B-314, S-42, M-130, B-307, DC-4, -6, -6B, -7, the B-377 Stratocruiser and the Constellation are outlined. Standard features on aircraft in the 1950s included pressurized cabins, fuel tanks integrated into the wings, anti-icing systems, enclosed wheel wells, hydraulically-boosted control surfaces, flush riveting and built-in passenger stairs. M.S.K.

A84-41648

AUTOMATION OF THE INSPECTION OF PART SHAPES USING COORDINATE-MEASURING MACHINES AT N.P. LET [AUTOMATIZACE KONTROLY TVARU DILCU S VYUZITIM SOURADNICOVYCH MERICICH STROJU V N.P. LET]

O. SIMAK Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 37-40. In Czech. refs

Trends in the development of coordinate-measuring machines (CMMs) and their use in mechanical engineering are examined. Attention is given to a project for the automation of setup procedures for a new transport aircraft, calling for the application of modern measuring devices for the checking of geometric precision. Performance data and operational characteristics of the CMMs used at N.P. LET are discussed. Also considered is the operation of numerical control (NC) machines and the development of measuring programs on the basis of mathematical models of aircraft geometry. B.J.

A84-42280*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AN OVERVIEW OF SOME MONOPLANAR MISSILE PROGRAMS

M. L. SPEARMAN (NASA, Langley Research Center, Hampton, VA) Joint Service Guidance and Control Committee Workshop on Bank-to-Turn Controlled Terminal Homing Missiles, Johns Hopkins University, Laurel, MD, September 19, 20, 1984, Paper. 25 p. refs

A historical review is presented of some monoplanar missile systems in which the vehicle flight control was similar to that for a conventional aircraft. The review is essentially chronological, beginning prior to World War I, and includes worldwide programs. Illustrative examples of aerodynamic research with monoplanar missiles are presented including some comparisons with cruciform missiles. Some examples of current programs are presented and some particular mission applications for monoplanar systems are discussed. Author

A84-42326

ATMOSPHERIC FLIGHT MECHANICS CONFERENCE, SEATTLE, WA, AUGUST 21-23, 1984, TECHNICAL PAPERS

Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1984, 523 p. For individual items see A84-42327 to A84-42376.

Among the topics discussed are maximum likelihood estimation methods, control inputs for parameter estimation, Space Shuttle Orbiter aerodynamic parameters, the effect of Karman vortex shedding on dynamic stall, helicopter parameter identification, a multidisciplinary data base and analysis for dynamic systems, circulation control airfoils for V/STOL application, stall/spin-related handling qualities for supersonic aircraft, ground simulations of VTOL IFR airworthiness criteria, and the autorotational characteristics of light airplane fuselages. Also discussed are the side moment exerted by a spinning projectile's two-component liquid payload, parabolized Navier-Stokes computations, viscous supersonic flow over finned bodies, an aeromaneuvering orbit transfer vehicle, military helicopter air-to-air capabilities, mission adaptive wing research concepts, and guided missile aerodynamics. O.C.

01 AERONAUTICS (GENERAL)

A84-42369#

AN ASSESSMENT OF HELICOPTER AIR-TO-AIR CAPABILITIES

D. S. HAGUE (Aerophysics Research Corp., Bellevue, WA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 449-457. (AIAA PAPER 84-2128)

There is a growing interest in the area of helicopter air-to-air combat due to the growing threat posed by armed helicopters. Such helicopters have potential against both rotary and fixed wing aircraft operating in their vicinity. In this paper the helicopter vs. helicopter air-to-air situation is first examined. Subsequently, the helicopter vs. fixed wing encounter is addressed. The red helicopter of this paper is typified by a conventional high performance vehicle carrying a turreted cannon and up to four air-to-air missiles. Blue helicopter characteristics are based on advanced helicopter performance capabilities and a similar weapon load. Blue fixed wing aircraft employed the F-4 Phantom with a full weapon load of IR and radar missiles and guns. Author

A84-42574

THE ROUTE STRUCTURE IN THE COMMERCIAL AIR TRAFFIC OF THE FEDERAL REPUBLIC OF GERMANY [DIE ROUTENSTRUKTUR IM GEWERBLICHEN LUFTVERKEHR DER BUNDESREPUBLIK DEUTSCHLAND]

E. URBATZKA (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, West Germany) DFVLR-Nachrichten (ISSN 0011-4901), vol. 42, June 1984, p. 37-41. In German.

A 'route structure' indicates the routes in an air traffic network which are used by the passengers to travel from the airport of departure to their destination, taking into account the percentage of passengers which were using various possible combinations of routes. The route structure of a traffic relation in airline traffic is illustrated with the aid of an example involving voyages between Hamburg and Spain. It is found that only 10.4 percent of all passengers are flying directly from Hamburg to Spain, while the remaining passengers are stopping first at an intermediate airport. Approximately 68 percent of all passengers are flying over Frankfurt as intermediate airport. Attention is given to the route structure related to flights within West Germany, the route structure in traffic between West Germany and another country, and investigations and comments regarding future route structures. G.R.

N84-28727*# Douglas Aircraft Co., Inc., Long Beach, Calif.

CONFIGURATION DESIGN STUDIES AND WIND TUNNEL TESTS OF AN ENERGY EFFICIENT TRANSPORT WITH A HIGH-ASPECT-RATIO SUPERCRITICAL WING

P. A. HENNE, J. A. DAHLIN, C. C. PEAHEY, and D. S. GERREN Washington NASA May 1982 185 p refs (Contract NAS1-15327)

(NASA-CR-3524; NAS 1.26:3524; ACEE-17-FR-1644) Avail: NTIS HC A09/MF A01 CSCL 01B

The results of design studies and wind tunnel tests of high aspect ratio supercritical wings suitable for a medium range, narrow body transport aircraft flying near $M=0.80$ were presented. The basic characteristics of the wing design were derived from system studies of advanced transport aircraft where detailed structural and aerodynamic tradeoffs were used to determine the most optimum design from the standpoint of fuel usage and direct operating cost. These basic characteristics included wing area, aspect ratio, average thickness, and sweep. The detailed wing design was accomplished through application of previous test results and advanced computational transonic flow procedures. In addition to the basic wing/body development, considerable attention was directed to nacelle/pylon location effects, horizontal tail effects, and boundary layer transition effects. Results of these tests showed that the basic 'cruise performance objectives were met or exceeded. Author

N84-28728# Naval Postgraduate School, Monterey, Calif.

THE ENFORCER AIRCRAFT PROGRAM: A LOWER-COST ALTERNATIVE WEAPON SYSTEM M.S. Thesis

R. P. HOLT and R. D. DOLAN Mar. 1984 90 p (AD-A141564) Avail: NTIS HC A05/MF A01 CSCL 01C

This research concerns a close air support weapon system known as the Enforcer aircraft. This system was first introduced to the military services from outside the formal competitive channels addressed in the procurement regulations. Although there is no specific operational requirement for an Enforcer type aircraft, it remains under consideration as a lower-cost alternative close support system in the so-called high/low mix acquisition strategy. The research analyzes the progress, to date, of the Enforcer as a system moving through the stages of the defense systems acquisition process. Emphasis is placed on the differing roles of the Enforcer's participants in that process. There is a detailed critical examination of an Air Force Enforcer cost effectiveness analysis and of the models used in that analysis. Conclusions and recommendations arising from the study are included, especially as they related to the expected defense acquisition environment in the latter half of the eighties. Author (GRA)

N84-28729#

Aeronautical Research Labs., Melbourne (Australia).

REPORT OF AN OVERSEAS VISIT TO THE USA, PART 2

G. LONG Jan. 1984 19 p (AD-A142054; ARL/STRUC-TM-374) Avail: NTIS HC A02/MF A01 CSCL 01C

This report describes an overseas visit to the USA made by the author. Visits were made to General Dynamics, Fort Worth to discuss F11C and to McAir, St. Louis to discuss F/A-18. The author also attended a meeting of TTCP Subgroup H as Australian National Leader. Part 1 of the report describes the visits made to General Dynamics and McAir, and Part 2 describes the TTCP meeting. Author (GRA)

N84-28730# Army Concepts Analysis Agency, Bethesda, Md. Force Systems Directorate.

AIRCRAFT SPARE STOCKAGE METHODOLOGY (AIRCRAFT SPARES) STUDY Final Report, Aug. 1983 - Mar. 1984

S. L. PENN, R. D. MCADOO, H. D. FREAR, W. A. BAUMAN, and V. E. JUGAN Apr. 1984 163 p

(AD-A142259; CAA-SR-84-12) Avail: NTIS HC A08/MF A01 CSCL 05A

The Aircraft Spare Stockage Methodology Study was conducted primarily to provide the Army with an analytical tool for quick reaction, gross estimation of wartime spare parts requirements and costs as they relate to flying hour and availability objectives. An ability to identify problem parts and possible causes of the problems was also desired. The study compares the potential of five models--Overview, PARCOM, SESAME, and ACIM, and Dyna-METRIC--to meet the study objectives. Overview and PARCOM are recommended for complementary use in estimating wartime spare parts requirements, while Dyna-METRIC is recommended for more in-depth evaluation before its suitability for application to the problem is determined. Data collected and validation problems associated with all the models examined are discussed. Author (GRA)

N84-28731# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).

FLEXIBLE MANUFACTURING LINE FOR AIRCRAFT STRUCTURES OF SHEET METAL Final Report, Dec. 1982

R. D. STUTZ and H. BECKER Bonn Bundesministerium fuer Forschung und Technologie Apr. 1984 97 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-W-84-011; ISSN-0170-1339; TF211/152-08-83) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 20,50

An automated manufacturing system for sheet metal aircraft structures is presented. Numerically controlled contour machining, heat treatment with glycol quenching, high pressure techniques,

and computer assisted storage and transport techniques were developed. Results show a global manufacturing cost reduction of 25% resulting from reduced finishing operations, shortened processing time, increased efficiency, and shortened nonproductive operations.
Author (ESA)

N84-29847*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOME AERODYNAMIC DISCOVERIES AND RELATED NACA/NASA RESEARCH PROGRAMS FOLLOWING WORLD WAR 2

M. L. SPEARMAN Jun. 1984 28 p refs
(NASA-TM-86258; NAS 1.15:86258) Avail: NTIS HC A03/MF A01 CSCL 01B

The World War 2 time period ushered in a new era in aeronautical research and development. The air conflict during the war highlighted the need of aircraft with agility, high speed, long range, large payload capability, and in addition, introduced a new concept in air warfare through the use of guided missiles. Following the war, the influx of foreign technology, primarily German, led to rapid advances in jet propulsion and speed, and a host of new problem areas associated with high-speed flight designs were revealed. The resolution of these problems led to a rash of new design concepts and many of the lessons learned, in principle, are still effective today. In addition to the technical lessons learned related to aircraft development programs, it might also be noted that some lessons involving the political and philosophical nature of aircraft development programs are worth attention.

Author

N84-29848# Bell Telephone Labs., Inc., Greensboro, N. C. Federal Systems Div.

STUDY OF THE FAA (FEDERAL AVIATION ADMINISTRATION) PROGRAM TO MODERNIZE MAINTENANCE OPERATIONS Engineering Report, Oct. 1983 - Apr. 1984

P. F. SENNEWALD, H. W. GUSTAFSON, and P. B. TAYLOR
Washington, D.C. FAA May 1984 60 p
(Contract DTFA01-84-C-0010)
(AD-A142295; DOT/FAA/ES-83/12) Avail: NTIS HC A04/MF A01 CSCL 05A

This report is an evaluation of the FAA's program to modernize the National Airspace System and reduce maintenance and operation costs through replacement of present systems with state-of-the-art equipment, centralization of the maintenance work force and remote monitoring of equipment/facilities. A conclusion of the study was the FAA's Maintenance Program which is a viable approach to meeting these goals. The AT&T study team made seven recommendations they believed would ensure improved productivity and reduced operating costs. The objectives of the AT&T study were to evaluate the FAA's modernization program, and then, based on AT&T's experience in their modernization effort, make recommendations to improve the FAA's program. The recommendations can be generalized into three areas which are: (1) Separate the monitoring and control of facilities from the automation and centralization of operations, thereby enabling independent efforts in those areas, (2) Establish an overall program management plan, and (3) Establish a model for centralization of the work force in the automated environment.

Author (GRA)

N84-29849# Air Force Academy, Colo. Dept. of Aeronautics. **AIR FORCE ACADEMY AERONAUTICS DIGEST Final Report**
J. DEJONGH, ed., W. HEISER, ed., and R. HOGGE, ed. Mar. 1984 176 p
(AD-A142399; USAFA-TR-84-5) Avail: NTIS HC A09/MF A01 CSCL 20D

Contents: External Flow-Field Measurements on a Top-Mounted, Inlet-Vatol Configuration at High Angles of Attack; Experimental Measurements of Wake Characteristics of Low Aspect-Ratio Delta and Flapped-Plate Planforms; The Early Days of Aeronautics; Uncertainty Analysis: A New Computer Subroutine; One-Dimensional Unsteady Isentropic Gas Flow; The Myth of Objectivity in the Writing of Engineers.
GRA

N84-29850# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NO. 1984-1, 218/ JANUARY - FEBRUARY

C. SEVESTRE, ed. Paris ESA Jun. 1984 81 p refs
Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimestrial (Paris), No. 1984-1/218, Jan. - Feb. 1984 81 p
(ESA-TT-858) Avail: NTIS HC A05/MF A01; print copy in ENGLISH available at ONERA, FF 60; original report in FRENCH available at ONERA Paris FF 60

Numerical simulation of homogeneous, isotropic, two-dimensional turbulence in compressible flow; a semi-implicit and unsteady numerical method of viscous-inviscid interaction for transonic separated flows; experimental determination of the response of a solid propellant to high-frequency pressure oscillations; blade bending flutter in supersonic flow; and skin friction measurements with hot-element gages are discussed.

Author (ESA)

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A84-39872

A NUMERICAL METHOD FOR CALCULATING SUPERSONIC FLOW PAST AIRCRAFT WINGS [CHISLENNYI METOD RASCHETA SVERKHZVUKOVOGO OBTEKANIYA KRYL'EV LETATEL'NYKH APPARATOV]

G. P. VOSKRESENSKII Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 24, June 1984, p. 900-915. In Russian. refs

A numerical method is proposed for solving the problem of supersonic flow past wings of arbitrary configurations. In particular, attention is given to the case involving a detached shock wave at the blunt leading edge of a wing. The solution region is divided into three subregions, in accordance with the characteristic parts of the wing, with each subregion having its own systems of coordinates. The system of gas dynamic equations for a nonviscous gas is solved using implicit second-order difference schemes. The approach proposed here is illustrated by examples in which flow calculations are made for wings of different types.
V.L.

A84-39970*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A NUMERICAL STUDY OF THE TWO- AND THREE-DIMENSIONAL UNSTEADY NAVIER-STOKES EQUATIONS IN VELOCITY-VORTICITY VARIABLES USING COMPACT DIFFERENCE SCHEMES

T. B. GATSKI (NASA, Langley Research Center, Hampton, VA) and C. E. GROSCH (Old Dominion University, Norfolk, VA) International Conference on Numerical Methods in Fluid Dynamics, 9th, Gif-sur-Yvette, Essonne, France, June 25-27, 1984, Paper. 6 p.

A compact finite-difference approximation to the unsteady Navier-Stokes equations in velocity-vorticity variables is used to numerically simulate a number of flows. These include two-dimensional laminar flow of a vortex evolving over a flat plate with an embedded cavity, the unsteady flow over an elliptic cylinder, and aspects of the transient dynamics of the flow over a rearward facing step. The methodology required to extend the two-dimensional formulation to three-dimensions is presented.

Author

A84-39997

CERTAIN EXACT SOLUTIONS TO PROBLEMS CONCERNING FLOW PAST A PROFILE NEAR A RECTILINEAR BOUNDARY (QUASI-THEORETICAL PROFILES) [NEKOTORYE TOCHNYE RRESHENIIA ZADACHI OB OBEKANII PROFILIA VBLIZI PRIAMOLINEINOI GRANITSY /KVAZITEORETICHESKIE PROFILI/]

A. V. KUZNETSOV (Kievskii Inzhenerno-Stroitel'nyi Institut, Kiev, Ukrainian SSR) and V. I. PUTIATA (Gidromekhanika (ISSN 0367-4088), no. 49, 1984, p. 34-41. In Russian. refs

A method is proposed for the analysis of potential bounded flow past profiles. This case is considered to be important for studying flow effects on profiles near the ground. The resulting profiles are called quasi-theoretical since, in contrast to theoretical solutions, exact solutions for the profiles are found only for fixed values of angles of attack and relative distance to the boundary.

I.H.

A84-40025*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECTS OF NOZZLE DESIGN PARAMETERS ON THE EXTENT OF QUIET TEST FLOW AT MACH 3.5

I. E. BECKWITH, D. M. BUSHNELL (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA), M. R. MALIK, and F.-J. CHEN (High Technology Corp., Hampton, VA) International Union of Theoretical and Applied Mechanics, Symposium on Laminar-Turbulent Transition, 2nd, Novosibirsk, USSR, July 9-13, 1984, Paper. 13 p. refs

Tests results at the NASA Langley Research Center, involving a Mach 3.5 pilot quiet tunnel, have shown that laminar-layered nozzle walls improve boundary layer stability and reduce stream disturbance levels caused by eddy Mach wave radiation. This type of wall design is required to obtain transition Reynolds numbers on tests models as high as those previously observed in supersonic flight vehicles. The Mach 3.5 pilot nozzle wall boundary layers were tested for Tollmein-Schlichting and Goertler linear amplification, and, in an analysis of Goertler vortices in two axisymmetric Mach 5 nozzles, transition values were found to vary. These values were applied to several nozzles with similar throat heights but different expansion rates. Among the nozzles included in the study, a flat-wall radial flow nozzle and a proposed rod-wall nozzle were tested. For the highest test unit Reynolds number, it was determined that the nozzle wall surface finish should not exceed 0.3 micron. Oil flow studies have indicated that Goertler vortex disturbances were the dominant mechanism causing transition on the walls of the pilot nozzle.

J.P.

A84-40074

GRID-SIZE REDUCTION IN FLOW CALCULATIONS ON INFINITE DOMAINS BY HIGHER-ORDER FAR-FIELD ASYMPTOTICS IN NUMERICAL BOUNDARY CONDITIONS

F. W. WUBS, J. W. BOERSTOEL, and A. J. VAN DER WEES (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 18, June 1984, p. 157-177. refs

An error analysis is presented of the numerical calculation of the steady flow on an infinite domain around a given airfoil by a domain-splitting (zonal) method. This method combines a fully-conservative finite-difference approximation on a finite domain around the airfoil with an approximate asymptotic solution outside this finite domain. The errors are analyzed as a function of the accuracy of the approximate asymptotic expansion, of the distance to the airfoil of the far-field boundary of the finite domain and of the mesh size. The numerical experiments show that, for a given desired accuracy level, large reduction in grid sizes are possible, if the usual far-field asymptotic approximation (uniform flow plus first-order perturbation by a circulation vortex at infinity) is augmented by only a few extra terms in the approximate asymptotic far-field solution. In this way, considerable numerical efficiency improvements can be realized. It is expected that this conclusion can be generalized to many other applications where computations on infinite domains are performed.

Author

A84-40241*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CALCULATION OF TRANSONIC FLOW IN A LINEAR CASCADE

L. F. DONOVAN (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 13 p. refs (AIAA PAPER 84-1301)

Turbomachinery blade designs are becoming more aggressive in order to achieve higher loading and greater range. New analysis tools are required to cope with these heavily loaded blades that may operate with a thin separated region near the trailing edge on the suction surface. An existing, viscous airfoil code was adapted to cascade conditions in an attempt to provide this capability. Comparisons with recently obtained data show that calculated and experimental surface Mach numbers were in good agreement but loss coefficients and outlet air angles were not. Previously announced in STAR as N84-24539

Author

A84-40775

THE ASYMPTOTIC ANALYSIS OF WAVE INTERACTIONS AND NUMERICAL CALCULATIONS OF TRANSONIC NOZZLE FLOW

H. M. GLAZ (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) and T.-P. LIU (U.S. Navy, Naval Surface Weapons Center, Silver Spring; Maryland, University, College Park, MD) Advances in Applied Mathematics (ISSN 0196-8858), vol. 5, June 1984, p. 111-146. Research supported by the John Simon Guggenheim Foundation, U.S. Navy, and NSF. refs

Transonic flow through a duct of variable cross section for which nonlinear resonance effects are important is considered. The complicated local interactions of nonlinear waves are resolved through asymptotic analysis and this is then used to construct a random choice method to calculate general unsteady flowfields. The method produces sharp shocks without oscillations, is accurate in smooth regions, and converges to a stable steady flow.

Author

A84-40799

NUMERICAL DESIGN OF PLANE AND AXISYMMETRIC SUPERSONIC NONEQUILIBRIUM-FLOW CHANNELS FOR OBTAINING NONUNIFORM OUTPUT CHARACTERISTICS

A. S. VOINOVSKII and V. I. KIREEV (Pis'ma v Zhurnal Tekhnicheskoi Fiziki, vol. 9, Aug. 26, 1983, p. 1015-1018) Soviet Technical Physics Letters (ISSN 0360-120X), vol. 9, Aug. 1983, p. 436, 437. Translation. refs

A numerical model was developed for the mixed boundary value problem of planar axisymmetric supersonic channel flow profiles with a central object and chemically reacting. The pressure distribution was assumed to be the generatrix of the central object. The gasdynamic and chemical parameters distributions were defined on a reference line in a supersonic region at the channel entrance. A solution was found using the method of characteristics over several layers of flow. An implicit difference scheme numerically integrated the chemical kinetic equations along the streamlines. Sample calculations are presented for the flow of combustion products of (CH₃)₂NNH₂ fuel, taking into consideration continuous and noncontinuous boundary conditions.

M.S.K.

A84-40813*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

THERMAL RESPONSE OF SPACE SHUTTLE WING DURING REENTRY HEATING

L. GONG, W. L. KO, and R. D. QUINN (NASA, Flight Research Center, Edwards, CA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 19th, Snowmass, CO, June 25-28, 1984. 16 p. refs (AIAA PAPER 84-1761)

A structural performance and resizing (SPAR) finite element thermal analysis computer program was used in the heat transfer analysis of the Space Shuttle Orbiter that was subjected to reentry aerodynamic heatings. One wing segment of the right wing (WS 240) and the whole left wing were selected for the thermal analysis. Results showed that the predicted thermal protection system (TPS)

temperatures were in good agreement with the space transportation system, trajectory 5 (STS-5) flight-measured temperatures. In addition, calculated aluminum structural temperatures were in fairly good agreement with flight data up to the point of touchdown. Results also showed that the internal free convection has a considerable effect on the change of structural temperatures after touchdown. Author

A84-40814*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THEORETICAL ANALYSIS OF AIRCRAFT AFTERBODY FLOW
G. S. DEIWERT, A. E. ANDREWS, and K. NAKAHASHI (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 22 p. refs
(AIAA PAPER 84-1524)

The strongly interactive flow field about aircraft afterbodies is investigated using computational techniques by which the thin-shear-layer formulation of the compressible, Reynolds-averaged Navier-Stokes equations is solved. A time-dependent implicit numerical algorithm is used to obtain solutions for a variety of afterbody and nozzle geometries, within the class of bodies of revolution, for both subsonic and supersonic external flow, and for sonic and supersonic underexpanded jets. Only centered nozzles with either a sharp lip or a blunt base are considered. In all cases, computed results are compared with experimental data taken at flight Reynolds numbers for like-flow conditions. Turbulence closure is realized using algebraic eddy-viscosity concepts. A new and unique adaptive-grid technique is used to resolve flow regimes with large gradients and to improve the accuracy and efficiency of the computational scheme. Special singular point boundary conditions are used for similar purposes, and are especially effective for highly under-expanded jets. For all cases considered, except one with a very large base-to-nozzle-exit-diameter ratio, the agreement with experimental measurements is excellent. For geometries with large base regions, enhancements in the turbulence transport model are necessary to support improvements in the flow-field simulation. Author

A84-40815#

THE THREE-DIMENSIONAL TURBULENCE TRANSPORT PROPERTIES IN THE BOUNDARY LAYERS OF CONICAL BODY CONFIGURATIONS AT MACH 3

D. W. AUSHERMAN and W. J. YANTA (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) American Institute of Aeronautics and Astronautics, Fluid Dynamics, Plasma Dynamics, and Lasers Conference, 17th, Snowmass, CO, June 25-27, 1984. 26 p. refs
(AIAA PAPER 84-1528)

Three-dimensional boundary layer measurements were carried out on 7 deg semivertex angle conical body configurations for angles-of-attack of 0, 2, and 4 deg in the Naval Surface Weapons Center Supersonic Tunnel Number Two. Tests were conducted at a freestream Mach number of 3.0 for a nominal freestream Reynolds number of 2.3 million/ft (7.5 million/m) with two different nosetips, a nominal 22 percent spherically blunt nose, and a severely indented nosetip which represented an ablated reentry shape. Measurements of the three mean velocity components, turbulence intensities, and Reynolds stresses were obtained at various circumferential locations around the body for one axial station, using a three-dimensional Laser Doppler Velocimeter system. In addition, surface Preston probe and static pressure measurements were obtained at five axial stations along the body. The effects of nose geometry, angle-of-attack, and model roll position on the three-dimensional boundary layer turbulence modeling parameters (such as eddy viscosity and mixing length) are discussed herein. Author

A84-40826#

COMPARISON OF MEASURED AND PREDICTED TRANSONIC FLOW AROUND AN AIRFOIL

P. J. BRYANSTON-CROSS (Churchill College, Cambridge, England) and J. D. DENTON (Cambridge University, Cambridge, England) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1025, 1026.

A two-dimensional numerical solution using an inviscid time marching method has been compared with interferometric data obtained from image plane holograms. This has been done over the whole blade profile including the trailing edge shock region, but a particularly detailed analysis has been made of the leading edge. The data obtained show isodensity/iso-Mach contours of 0.03 with a spacing of typically 50 microns between them. It was found that a highly refined grid size of similar resolution was required to compute an accurate solution. Author

A84-40827*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A NEW CONSISTENT SPATIAL DIFFERENCING SCHEME FOR THE TRANSONIC FULL-POTENTIAL EQUATION

J. FLORES, T. L. HOLST, D. KWAK (NASA, Ames Research Center, Applied Computational Aerodynamics Branch, Moffett Field, CA), and D. M. BATISTE AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1027-1034. refs

Previously cited in issue 5, p. 585, Accession no. A83-16678

A84-40828#

NUMERICAL SIMULATION OF TWO-DIMENSIONAL UNSTEADY TRANSONIC FLOWS USING THE FULL-POTENTIAL EQUATION

J. B. MALONE (Lockheed-Georgia Co., Marietta, GA) and N. L. SANKAR (Georgia Institute of Technology, Atlanta, GA) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1035-1041. refs

Previously cited in issue 5, p. 582, Accession no. A83-16601

A84-40830#

SUPERSONIC CONICAL SEPARATION DUE TO SHOCK VORTICITY

F. MARCONI (Grumman Aerospace Corp., Bethpage, NY) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1048-1055. refs

Previously cited in issue 17, p. 2451, Accession no. A83-38084

A84-40831*# Rutgers Univ., New Brunswick, N. J.

A HYBRID EXPLICIT-IMPLICIT NUMERICAL ALGORITHM FOR THE THREE-DIMENSIONAL COMPRESSIBLE NAVIER-STOKES EQUATIONS

D. D. KNIGHT (Rutgers University, New Brunswick, N.J.) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1056-1063. NASA-supported research. refs
(Contract AF-AFOSR-82-0040; AF-AFOSR-80-0072)

Previously cited in issue 5, p. 582, Accession no. A83-16593

A84-40832#

SEPARATION MODEL FOR TWO-DIMENSIONAL AIRFOILS IN TRANSONIC FLOW

F. A. DVORAK and D. H. CHOI (Analytical Methods, Inc., Redmond, WA) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1064-1070. refs
(Contract DAAG29-78-C-0004)

Previously cited in issue 5, p. 584, Accession no. A83-16638

A84-40836*# Informatics General Corp., Palo Alto, Calif.

NEW IMPLICIT BOUNDARY PROCEDURES - THEORY AND APPLICATIONS

M. M. RAI (Informatics General Corp., Palo Alto, CA) and D. S. CHAUSSEE (NASA, Ames Research Center, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1094-1100. refs

Previously cited in issue 5, p. 579, Accession no. A83-16536

02 AERODYNAMICS

A84-40842*# National Cheng Kung Univ., Tainan (Taiwan). NUMERICAL SIMULATIONS OF UNSTEADY TRANSONIC FLOW IN DIFFUSERS

M.-S. LIOU (National Cheng Kung University, Tainan, Republic of China) and T. J. COAKLEY (NASA, Ames Research Center, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1139-1145. Research supported by the McDonnell Douglas Independent Research and Development Program, and NASA. refs

Previously cited in issue 15, p. 2346, Accession no. A82-31959

A84-40846# A SOURCE-EQUALITY KUTTA CONDITION FOR PANEL METHODS

L. FORNASIER (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1167-1169. refs

Significant variations in overall circulation and local flow properties can result from different choices for the type and/or the location of the application point of the numerical Kutta condition. A source-equality condition is proposed that can be applied at an airfoil trailing edge, and its application to low-order and higher-order panel methods is presented to quantify the improvements achieved by the present model vis-a-vis two conventional forms. O.C.

A84-40858 TURBULENCE MEASUREMENTS IN AN EJECTOR WING FLOW FIELD

G. D. CATALANO (Louisiana State University, Baton Rouge, LA), H. E. WRIGHT (USAF, Institute of Technology, Wright-Patterson AFB, OH), and R. E. WALTERICK (Georgia Institute of Technology, Atlanta, GA) IN: Photon correlation techniques in fluid mechanics; Proceedings of the Fifth International Conference, Kiel and Damp, West Germany, May 23-26, 1982. Berlin, Springer-Verlag, 1983, p. 105-109. refs

Measurements were made of the turbulent flowfield on an ejector wing with a constant area mixing duct. The trials were run in a wind tunnel using smoke tracers and a laser velocimeter. The freestream velocity was around 8 m/sec and turbulence was 3-7 percent. The flowfield above the wing was consistently accelerated, and the effect extended upwind of the wing. Powering the ejector shifted the stagnation point downstream on the lower surface. Finally, streamlines above the wing surface were observed to compress toward the upper surface, suggesting that the wake region was reduced. M.S.K.

A84-40862 BASE FLOW MEASUREMENTS IN A TRANSONIC CASCADE USING A LASER TRANSIT ANEMOMETER

R. G. W. BROWN (Royal Signals and Radar Establishment, Malvern, Worcs., England) and P. H. RICHARDS (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England) IN: Photon correlation techniques in fluid mechanics; Proceedings of the Fifth International Conference, Kiel and Damp, West Germany, May 23-26, 1982. Berlin, Springer-Verlag, 1983, p. 192-196. refs

The results of using a laser transit anemometer (LTA) to measure the velocity, flow angle, and vortex shedding frequency in the base flow region near the trailing edge of a blade in a transonic turbine cascade are reported. The flowfield was numerically modeled with an inviscid method for two-dimensional vortex shedding. Dual orthogonally polarized laser beams separated by 450 microns shone through the flow into photomultipliers. Cross-correlations were generated from the digitized signals. The flow angle was derived from measurements at different laser angular settings and exhibited an accuracy to within 0.05 deg. A good match was also found with the vortex shedding frequencies observed above Mach 1 flow speeds. M.S.K.

A84-40890 WATER DROPLET TRAJECTORY COMPUTATION AROUND AN AIR INTAKE

H.-W. STOCK (Dornier GmbH, Friedrichshafen, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, May-June 1984, p. 200-208. refs

Water droplet trajectories around an air intake are computed in order to evaluate the impingement boundaries on the inlet and the amount of water which hits the inlet lip. The amount of water together with the impingement boundaries form the basis for the estimation of the ice growth on inlet lips under given atmospheric conditions. The flow field around the inlet is computed solving the Euler equations by a finite volume technique. The droplets are seeded into the gas velocity field at a place sufficiently upstream of the inlet, where the flow is almost unperturbed. The equations of motion for the droplet are solved and the impingement points on the inlet lip can be determined. Author

A84-41165 RADIATIVE AND CONVECTIVE HEAT TRANSFER INTERACTIONS IN THE THREE-DIMENSIONAL COMPRESSIBLE HYPERSONIC TURBULENT LAYER ON A SHARP CONE AT AN ANGLE OF ATTACK

G. N. KUMAR (Tuskegee Institute, Tuskegee, AL) and R. I. VACHON (Vachon, Nix and Associates, Atlanta, GA) IN: Thermal sciences 16; Proceedings of the Sixteenth Southeastern Seminar on Thermal Sciences, Miami, FL, April 19-21, 1982. Volume 1. Washington, DC, Hemisphere Publishing Corp., 1983, p. 419-442. refs

Interaction between radiation from an external source and the hypersonic boundary layer on a sharp cone at an angle of attack are determined by solving numerically the three-dimensional compressible turbulent boundary layer equations together with the energy equation modified to include thermal radiation. In the present analysis, the radiative properties of the medium (mainly the absorption coefficient) are approximated by breaking the wavelength spectrum into 'bands' so that within each band, the absorption coefficient is constant with respect to wavelength and is a function only of the local temperature and density. The energy equation then becomes a partial integro-differential equation which is coupled to the continuity and the momentum equations through the dependence of the various fluid properties on the local temperature. Turbulence is accounted for by making use of Prandtl's mixing length hypothesis with the van Driest modification for the region close to the wall. The coupled nonlinear equations are solved numerically to yield the velocity and temperature fields in the boundary layer as well as the heat transfer rates for different Reynolds and Mach numbers. Results from the present analysis have been compared with the earlier work by the authors which was based on the assumption of an optically thin medium. Author

A84-41326*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AERODYNAMIC CHARACTERISTICS OF SOME LIFTING REENTRY CONCEPTS APPLICABLE TO TRANSATMOSPHERIC VEHICLE DESIGN STUDIES

M. L. SPEARMAN (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 9 p. refs (AIAA PAPER 84-2146)

The aerodynamic characteristics of some lifting reentry concepts are examined with a view to the applicability of such concepts to the design of possible transatmospheric vehicles (TAV). A considerable amount of research has been done in past years with vehicle concepts suitable for manned atmospheric-entry, atmospheric flight, and landing. Some of the features of these concepts that permit flight in or out of the atmosphere with maneuver capability should be useful in the mission requirements of TAV's. The concepts illustrated include some hypersonic-body shapes with and without variable geometry surfaces, and a blunt

lifting-body configuration. The merits of these concepts relative to the aerodynamic behavior of a TAV are discussed. Author

A84-41327#
INVISCID TRANSONIC FLOW CHARACTERISTICS OF SHARP-EDGED RECTANGULAR WINGS

E. S. LARSON (Flygtekniska Forsöksanstalten, Bromma, Sweden) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. Research supported by the Armed Forces of Sweden. refs

(AIAA PAPER 84-2147)

An attempt to obtain continuous generalized aerodynamic coefficients and center of pressure locations for transonic flows over thin rectangular wings is reported. Semiempirical, analytic expressions were developed on the bases of results from approximate linear theory, transonic small disturbance theory and early experimental data. Results are provided for thickness/chord ratio variations, center of pressure/speed and the time-dependent evolution of the suction force numerical investigations. Further experimental data and reference to the full potential flow solutions to the Euler equations are required to perfect the techniques for implementation as aerodynamic prediction codes. M.S.K.

A84-41328#
THEORETICAL PREDICTION OF ROLL MOMENT ON WING-CONTROLLED MISSILE

S. AKISHITA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Hyogo, Japan), R. KUROSUKI (Mitsubishi Electric Corp., Kamakura, Kanagawa, Japan), K. OKADA, and T. HIRATA (Mitsubishi Research Institute, Inc., Ohtemachi, Tokyo, Japan) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 8 p. refs

(AIAA PAPER 84-2148)

The panel method solution for subsonic potential flow is applied to modeling a missile wing-body-tail configuration in order to characterize the roll moments. An inviscid, nonrotating incompressible flow is described with the three-dimensional Laplace equation for the perturbation velocity potential. The trailing vortex sheet shed from the wing is modeled as a discrete set of vortex filaments whose strength is determined with a collocation method for the panels. Comparison with previous experimental data displays acceptable agreement for horizontal and vertical wing deflection. The effect of the tail arrangement on the roll moment is calculated and shows that an interdigitated configuration will prevent a reverse roll moment from appearing on the surfaces. The roll moment on the tails also decreases with the tail span ratio. M.S.K.

A84-41331#
EFFECT OF UPSTREAM PARALLEL FLOW ON TWO-DIMENSIONAL WIND-TUNNEL TESTS

T. J. AKAI (Notre Dame, University, Notre Dame, IN) and U. PIOMELLI American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 6 p. refs

(AIAA PAPER 84-2153)

The effect of flow conditions at the entrance of a test section on two-dimensional wind-tunnel tests is qualitatively examined by imposing a parallel flow at a finite distance upstream of the airfoil model. A potential flow formulation is made for this problem and solved by a vortex panel method. The major effect of the upstream parallel flow is to reverse effects caused by blocking. Such a reversal is aggravated by large tunnel height-to-chord ratios. For smaller heights, where the parallel flow assumption is likely to be more reasonable, upstream effects become negligible if the test section starts more than about 2 to 4 chord lengths upstream of the airfoil. Author

A84-41332#

AN ITERATIVE PROCEDURE FOR THREE-DIMENSIONAL TRANSONIC WING DESIGN BY THE INTEGRAL EQUATION METHOD

S. TAKANASHI (National Aerospace Laboratory, Tokyo, Japan) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 11 p. refs

(AIAA PAPER 84-2155)

A practical design method is presented for three-dimensional transonic wings with prescribed pressure distributions. The method is based on an iterative 'residual-correction' concept. The residual, defined as the difference between the computed and the prescribed pressure distributions at each iteration step, is determined by the use of an existing direct analysis code for a transonic wing with or without body, and the wing geometry correction to compensate for the residual can be approximately obtained from the inverse solution code developed in the present study. The inverse (correction) problem is mathematically reduced to a Dirichlet boundary value problem which is solved here by the aid of the transonic integral equation method. Some of the design results are also presented for a transonic swept wing. Author

A84-41333#

TRANSONIC AERODYNAMIC COMPUTATIONS FOR A CANARD CONFIGURATION

N. AGRELL (Flygtekniska Forsöksanstalten, Bromma, Sweden) and L. ELMELAND (SAAB-Scania AB, Linköping, Sweden) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 6 p. Research supported by the Swedish Defence Material Administration. refs

(AIAA PAPER 84-2158)

A comparison of wind tunnel data with the predictions of two numerical models for the flow around a closely coupled canard-wing configuration with low aspect ratio is presented. A transonic small perturbation (TSP) model comprised a perturbation expressed as a function of the full velocity potential, a transonic small disturbance equation, constant pressure coefficients and wing deformations defined as rotations. The second simulation was performed with a linearized panel method, covering the speed ranges up to Mach 0.9 and from Mach 1.2-2. The panel method gave accurate results for angle of attack simulations while the TSP yielded values that were too low when compared with data. Both models overpredicted the effects of elevon deflections, yet both correctly analyzed the influence of static aeroelasticity on elevon effectiveness. M.S.K.

A84-41334*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EVALUATION OF A VELOCITY-SPLIT SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR FIGHTER FOREBODIES

S. F. YAROS (NASA, Langley Research Center, Hampton, VA) and R. R. COSNER (McDonnell Douglas Aircraft Corp., St. Louis, MO) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 14 p. refs

(AIAA PAPER 84-2160)

A velocity-splitting method of solving the three-dimensional Navier-Stokes equations, originally designed for afterbody flows, is examined for its applicability for predicting fighter forebody flows. Results from the AFTEND Code are compared with wind tunnel data for two fighter configurations at a Mach number of 0.9 and angles-of-attack from 0 deg to 20 deg. Results compare well with data, and in areas where data do not exist, the viscous AFTEND results show realistic effects of viscosity compared to inviscid predictions. The inviscid results themselves are in general superior to results obtained from a small-disturbance transonic potential code. Author

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A84-41338#

DESIGN USING EULER EQUATIONS

K. K. MANI (Lockheed-California Co., Burbank, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. refs (AIAA PAPER 84-2166)

A method for designing two-dimensional airfoils using Euler equations is described in this paper. An analysis program developed by Jameson, based on finite volume method is used as the basic program for this development. The design is carried out with the objective of producing an airfoil shape which will develop a pressure distribution similar to a prescribed target pressure. The necessary modifications to the airfoil geometry is obtained by superposition of a number of smooth and small bumps. The characteristic dimensions of these bumps are calculated subject to a least square minimization of the area enclosed between the target pressure and the pressure developed by an initial airfoil shape. The airfoil generated in this manner has a tendency to have a wave-like surface. A smoothing procedure is optionally invoked in order to remove this unevenness. A few design results are presented here in order to demonstrate the capability of this approach. Author

A84-41339#

ESTIMATION OF WAKE ROLLUP OVER SWEEP WINGS

J. K. NATHMAN (Analytical Methods, Inc., Redmond, WA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 9 p. refs (AIAA PAPER 84-2174)

The paper describes the theory and application of a wake preprocessor for panel methods that use an iterative procedure to determine the position of strongly interacting vortex sheets. The estimation is based on slender body theory with separation. Leading-edge wakes for a delta and straked wing are constructed and used in a three-dimensional panel method. The wake structures compare reasonably well to experimentally observed vortex core positions, while calculated pressures on the wings with the estimated wakes compare well near the nose but less well near the trailing edge. Author

A84-41340*# North Carolina State Univ., Raleigh.

NUMERICAL AND EXPERIMENTAL DETERMINATION OF SECONDARY SEPARATION ON DELTA WINGS IN SUBSONIC FLOW

F. R. DEJARNETTE (North Carolina State University, Raleigh, NC) and S. H. WOODSON American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p. refs (Contract NCCI-22; NCCI-46) (AIAA PAPER 84-2175)

A quasi-three-dimensional boundary layer method for conical inviscid flows is presented. The model was developed to characterize the flow fields over slender delta wings, particularly the shed vortex sheet. A steady, incompressible, laminar boundary layer is assumed and a solution is obtained with the Smith (1966) finite difference code. Predictions are compared with oil flow patterns and surface pressure measurements for 74 and 80 deg delta wings at 0-20 deg angles of attack. The model is capable of accurately predicting the secondary separation lines. Inviscid velocities derived from panel methods lead, however, to inaccurate pressure distributions. M.S.K.

A84-41341#

REYNOLDS NUMBER EFFECT ON THE AERODYNAMIC CHARACTERISTICS OF AN OGIVE-CYLINDER AT HIGH ANGLES OF ATTACK

P. CHAMPIGNY (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 8 p. refs (AIAA PAPER 84-2176)

The results of forces and surface pressure measurements on an axisymmetric nose (ogive) cylinder at high angles of attack in

the ONERA F1 pressurized wind tunnel are reported. Re from 280,000-2,000,000 and angles of attack from 0-80 deg were examined using pressure taps and oil flow patterns. Only the flow component normal to the cylinder had a significant impact. However, large side forces appeared in the laminar and fully turbulent separation regimes, and were of greatest magnitude in the low transition regime. The side force distributions were determined to be sinusoidal. M.S.K.

A84-41342#

FLOW PHENOMENA CAUSING WING AND BODY ROCK

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p. refs (AIAA PAPER 84-2177)

Limit cycle oscillations in roll of advanced aircraft can result from three different fluid mechanical flow processes. The so called slender wing rock is caused by asymmetric vortex shedding from highly swept wing leading edges. A completely different flow mechanism causes wing rock for aircraft with moderately swept wing leading edges. In this case the causative mechanism is dynamic airfoil stall. Finally, if the aircraft has a slender forebody, the rocking motion can be generated by asymmetric body vortices from the nose, which interact with an asymmetric aft body. Even the asymmetry caused by the aircraft canopy can be enough to establish a rocking motion. Author

A84-41343#

UNSTEADY AERODYNAMICS OF ARTICULATE LIFTING BODIES

J. C. WU (Georgia Institute of Technology, Atlanta, GA) and H. HU-CHEN American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 14 p. refs (Contract AF-AFOSR-82-0108) (AIAA PAPER 84-2184)

A general procedure for analyzing unsteady aerodynamics of lifting bodies formed by joining together rigid segments moving relative to each other is described. It is shown that a general theory of aerodynamics, developed on the basis of viscous flow equations, can be used to identify important flow elements dominating the aerodynamics of unsteady flows and to evaluate the individual contributions of these elements. An application of the general procedure to the Weis-Fogh problem is discussed. Closed form expressions for the lift and the power expenditure associated with the Weis-Fogh problem are presented and discussed. Author

A84-41344*# Wichita State Univ., Kans.

NATURAL LAMINAR FLOW FLIGHT EXPERIMENTS ON A SWEEP-WING BUSINESS JET

W. H. WENTZ, JR. (Wichita State University, Wichita, KS), R. NYENHUIS (Cessna Aircraft Co., Wichita, KS), and A. AHMED American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. NASA-supported research. refs (AIAA PAPER 84-2189)

Flight test experiments have been conducted to measure the extent and nature of laminar flow on a smoothed test region of a swept-wing business jet. Surface hot film anemometers and sublimating chemicals were used for transition detection. Surface pressure distributions were measured using pressure belts. Instrumentation techniques and problems are presented. Correlation was obtained between the hot film and sublimating chemicals for transition detection. Taylor-Goertler vortices were observed for some flight conditions. Boundary layer stability analysis is being conducted using measured pressure distributions to determine the correlation possible for transition prediction on swept wings. Author

A84-41345*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

IMPACT OF FUSELAGE INCIDENCE ON THE SUPERSONIC AERODYNAMICS OF TWO FIGHTER CONFIGURATIONS

R. M. WOOD and D. S. MILLER (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 8 p. refs
(AIAA PAPER 84-2193)

The results of experimental and theoretical investigations into the effect of fuselage upwash on fighter aircraft wing performance are reported. Wind tunnel trials were performed on 4 percent scale models of two supersonic fighters. The trials were run at Mach 1.6-2.0, an Re of 2,000,000 and at angles of attack (AOA) of -4 to 20 deg. Measurements were made of lift, drag and pitching moments. Two linearized theory supersonic aerodynamic prediction codes, PAN AIR and the SDAS lift analysis, were used to predict the same aerodynamic coefficients. The fuselage AOA augmented the lift and pitching moment at 0, 2 and 5 deg. The contribution mainly arose from the fuselage-induced upwash. The PAN AIR code gave superior data for the fuselage aerodynamics and effects, although both codes accurately predicted the overall lift and moment increments due to the fuselage AOA. M.S.K.

A84-41347*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC EFFECTS OF DISTRIBUTED SPANWISE BLOWING ON A FIGHTER CONFIGURATION

J. K. HUFFMAN, D. E. HAHNE (NASA, Langley Research Center, Hampton, VA), and T. D. JOHNSON, JR. (Kenton International Inc., Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. refs
(AIAA PAPER 84-2195)

The results of wind tunnel tests at NASA Langley targeted at the performance and configurational characteristics of 0.1 and 0.13 scale model spanwise blowing (SWB) jet wing concepts are reported. The concept involves redirection of engine compressor bleed air to provide SWB at the fuselage-wing juncture near the wing leading edge. The tests covered the orientation of the outer panel nozzles, the effects of SWB operation on the performance of leading and trailing edge flaps and the effects of SWB on lateral stability. The trials were run at low speeds and angles of attack from 24-45 deg (landing). Both lift and longitudinal stability improved with the SWB, stall and leading edge vortex breakdown were delayed and performance increased with the SWB rate. Lateral stability was degraded below 20 deg angle of attack while instabilities were delayed above 20 deg due to roll damping. M.S.K.

A84-41348#

ANALYSIS OF STALLED MULTI-ELEMENT AIRFOILS

B. R. GILMER, D. W. JASPER, and D. R. BRISTOW (McDonnell Aircraft Co., St. Louis, MO) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 11 p. refs
(Contract N00019-82-C-0369)
(AIAA PAPER 84-2196)

An iterative viscous-inviscid interaction method is presented for predicting the pressures, forces and moments of an arbitrary multi-element airfoil with massive turbulent separation in incompressible, steady flow. In each iteration cycle, the viscous-inviscid interaction is explicitly modeled by a mathematical expansion to a boundary layer method and a panel method. Linear terms are retained to account for the complete first order coupling between the viscous and inviscid equations. The system of linear, algebraic equations is solved for the perturbations to the displaced streamline geometries. Example calculations are presented that demonstrate reliable convergence and good agreement with wind tunnel data. Author

A84-41349#

VISCOUS-INVISCID SIMULATION OF UPPER SURFACE BLOWN CONFIGURATIONS

J. P. NARAIN (Lockheed-Georgia Co., Marietta, GA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 7 p. Research supported by Lockheed-Georgia Co. refs
(AIAA PAPER 84-2200)

The upper-surface blown configuration is investigated using an inviscid panel method and viscous jet theories. An integral method is used to predict the decay of a turbulent three-dimensional wall jet on a curved surface in a nonuniform external flow field. Aft of the trailing edge, the jet location and decay is calculated using jet in cross flow theory. Correlations of the theoretical predictions with experimental data give reasonably good agreement. Author

A84-41350#

DESIGN, WIND TUNNEL TESTING AND RATIONAL ANALYSIS OF A VENTRAL PITOT-TYPE AIR INTAKE

D. WELTE (Dornier GmbH, Friedrichshafen, West Germany) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 9 p. Research supported by the Bundesministerium der Verteidigung. refs
(Contract BMVG-RU-FO-4)
(AIAA PAPER 84-2202)

A pitot-type air inlet in an underbelly location for a single-engine, supersonic fighter configuration was designed. Compared to a similar inlet of an existing light weight fighter aircraft, a fuselage integrated 11 deg ramp in front of the inlet was chosen to extend the Mach-number for good total pressure recovery up to 1.6. A wind tunnel program was performed at low and high speeds and up to very high angles of attack. The test results are discussed including a rational analysis of the supersonic inlet flow field. Author

A84-41351#

AERODYNAMIC INTERACTIONS OF WINGTIP FLOW WITH DISCRETE WINGTIP JETS

J. M. WU, A. D. VAKILI, and F. T. GILLIAM (Tennessee, University, Tullahoma, TN) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 12 p. refs
(Contract F33615-81-K-3034)
(AIAA PAPER 84-2206)

Wind and water tunnel data and calculations of the effects on wing aerodynamic performance by the presence of discrete wing tip jets are reported. A NACA 0012-64 airfoil equipped for interchangeable tips that provided various blowing configurations was used in the tests. Data were gathered on forces and moments at three spanwise locations and dye injection provided flow visualization. A relatively small jet had a large effect on the spanwise pressure distribution. Three separate types of boundary vortices were produced by the tip jets: spin-off vortices extending into the potential flow region, auxiliary vortices parallel to the main flow and entrained vortices in the jet and wingtip vortices. Wake vortices were dispersed while total circulation increased, thereby effectively enhancing the aspect ratio and overall wing performance. M.S.K.

A84-41353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ASSESSMENT OF PRELIMINARY PREDICTION TECHNIQUES FOR WING LEADING-EDGE VORTEX FLOWS AT SUPERSONIC SPEEDS

R. M. WOOD and D. S. MILLER (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 14 p. refs
(AIAA PAPER 84-2208)

The applicability of existing theoretical models for predicting wing leading edge separated flow characteristics for high-lift supersonic flight was examined with regard to previous

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experimental force, pressure and flow visualization data. Correlations of data on uncambered delta wings revealed that the upper surface normal force and minimum pressure coefficients decreased nonlinearly with increasing angles of attack. The attainable vacuum pressure decreased with increasing Mach number, while the lower surface normal force increased nonlinearly with increasing speed. The LISTAR and VORCAM linear theory aerodynamic codes generated predictions for comparison with the data. LISTAR displayed better agreement with measured vortex strength and position and lifting characteristics than did VORCAM. The Euler code SWINT was ill-suited to calculating wing performance in separated flows at high lift and low supersonic speeds. M.S.K.

A84-41630#

AN EXPERIMENTAL STUDY OF ROTATING STALL IN A MULTISTAGE AXIAL-FLOW COMPRESSOR

D. K. DAS (New York State University, Utica, NY) and H. K. JIANG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 542-551. refs
(ASME PAPER 83-GTJ-20)

The flow field and the distribution of the flow parameters in the rotating stall regime in a three stage axial flow compressor were obtained in detail using three-hole cylindrical probes containing fast response transducers in association with a digital data acquisition system and an ensemble averaging technique. An appreciable amount of experimental data are presented in this paper with a critical discussion on those. Author

A84-41631#

THREE-DIMENSIONAL STRUCTURE AND DECAY OF VORTICES BEHIND AN AXIAL FLOW ROTATING BLADE ROW
M. INOUE and M. KUROMARU (Kyushu University, Fukuoka, Japan) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 561-569. refs
(ASME PAPER 83-GTJ-21)

Detailed measurements were made of the three-dimensional turbulent flow field behind an axial-flow rotating blade row. The flow was surveyed at 15 radial locations and 70 circumferential sampling points in five measuring planes parallel to the trailing edge of the rotor. Statistically accurate mean velocities as well as turbulence stresses were obtained from numerous hot-wire signals, more than 12,000 for each sampling point. Vorticities were derived by the numerical differentiation of these data. The three-dimensional structure of various kinds of vortices generated through the rotor, such as a leakage vortex, trailing vortices, scraping vortices, a horseshoe vortex, etc., were elucidated quantitatively by use of the local streamwise, lateral and normal components of vorticity. The decay characteristics of these vortices were investigated in relation to the distribution of the turbulent stresses. Author

A84-41632#

INFLUENCE OF DIHEDRAL ON THE SECONDARY FLOW IN A TWO-DIMENSIONAL COMPRESSOR CASCADE

F. A. H. BREUGELMANS, Y. CARELS, and M. DEMUTH (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genese, Belgium) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 578-584. refs
(ASME PAPER 83-GTJ-12)

A discussion is conducted on the experimental facility, instrumentation, results obtained, and compressor cascade model used in an investigation of the effect of blade dihedral on secondary flow evolution in a rectilinear compressor cascade at nominal incidence. Strong influence of dihedral on the secondary flow is noted, with the overall loss and loss distribution in the spanwise direction being modified in important ways. Additional correlations are judged necessary in detailed flow prediction methods. O.C.

A84-41633#

A STUDY OF AXIAL TURBINE LOSS MODELS IN A STREAMLINE CURVATURE COMPUTING SCHEME

R. K. SULLEREY (Indian Institute of Technology, Kanpur, India) and S. KUMAR (Defence Research and Development Organization, Hyderabad, India) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 591-597. refs

This paper describes a study of the suitability of various loss models for axial turbines as assessed with a streamline curvature computing scheme for the meridional flow involved. The important loss models in this study include the Balje/Binsley loss correlation and its modification, and a recently modified form of the Ainley/Mathieson/Dunham/Came loss correlation. Test cases for the application of the computing scheme include single-, three-, and four-stage turbines for which extensive design and measured data are available. The computed results have been compared with test results for design and off-design mass flow rates and design pressure ratio. The results indicate that the Balje/Binsley profile loss correlation with the modified Dunham/Came secondary loss correlation give results that compare best with measured data. A modified form of the Ainley/Mathieson/Dunham/Came loss model is nearly as accurate. Author

A84-41636#

ON THE THEORY OF THE WELLS TURBINE

L. M. C. GATO and A. F. DE O. FALCAO (Lisboa, Universidade Tecnica, Lisbon, Portugal) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 628-633. Research supported by the Instituto Nacional de Investigacao Cientifica. refs
(ASME PAPER 84-GT-5)

A theoretical investigation is presented concerning the aerodynamic performance of the Wells turbine, a self-rectifying, axial-flow turbine suitable for energy extraction from a reciprocating air flow. A two-dimensional analysis is developed, and expressions, based on potential flow, are derived for the blade shape maximizing the turbine efficiency. Three-dimensional effects and profile losses are then accounted for by means of an actuator disk theory, which shows that large radial distortions of axial velocity profile can occur, depending on blade shape, with important implications on the extent of the stall-free conditions. Author

A84-41638#

A HORSESHOE VORTEX IN A DUCT

J. MOORE and T. J. FORLINI (Virginia Polytechnic Institute and State University, Blacksburg, VA) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 668-676. refs
(ASME PAPER 84-GT-202)

A Rankine half-body is used to model the three-dimensional flow caused by a blunt obstruction in a flow passage. The body is located in a duct bounded by two plane endwalls and two side walls shaped like potential-flow streamlines. A thick turbulent boundary layer on the endwall forms a horseshoe vortex flow as it encounters the leading edge of the body. Flow measurements are presented showing the inlet flow and the three-dimensional flow downstream of the leading edge. Sufficient data are presented for this to be a test case for the development of three-dimensional viscous flow codes. Author

A84-41643#

BLOCKAGE IN AXIAL COMPRESSORS

R. P. DRING (United Technologies Research Center, East Hartford, CT) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 712-714. refs
(Contract F33615-77-C-2083)

The treatment of aerodynamic data presently used in consideration of the phenomenon of blockage in axial compressors facilitates the interpretation of comparisons between computed throughflow results and measured data. The spanwise distributions of loss, deviation, and blockage specified by these means offer a

firm basis for the assessment of throughflow calculation methods and permit the estimation of the magnitude of the errors associated with the inference of blockage. O.C.

A84-41806

STRUCTURE OF A HIGH-REYNOLDS-NUMBER TURBULENT WAKE IN SUPERSONIC FLOW

J. P. BONNET, V. JAYARAMAN, and T. ALZIARY DE ROQUEFORT (Poitiers, Université, Poitiers, France) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 143, June 1984, p. 277-304. Sponsorship: Direction des Recherches, Etudes et Techniques. refs (Contract DRET-82-169-2)

The present investigation is concerned with an experimental study of a high-Reynolds-number wake in supersonic flow, taking into account space and space-time correlation measurements conducted with the aid of hot-wire anemometry. The results of the study indicate that the two initially turbulent boundary layers at the trailing edge generate two statistically independent sides of the wake. In the developed part of the wake, all the space and space-time characteristics reach an asymptotic state. It is found that in this region the essential features do not agree with the classical results for the incompressible, initially laminar wake behind the cylinder. G.R.

A84-41808

PRANDTL-BACHELOR FLOW PAST A FLAT PLATE WITH A FORWARD-FACING FLAP

P. G. SAFFMAN and S. TANVEER (California Institute of Technology, Pasadena, CA) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 143, June 1984, p. 351-365. Navy-supported research. refs (Contract DE-AM03-76SF-00767)

Two-dimensional steady inviscid flow past an inclined flat plate with a forward-facing flap attached to the rear edge is considered for the case when a vortex sheet separates from the leading edge of the flat plate and reattaches at the leading edge of the flap, with uniform vorticity distributed between the vortex sheet and the body. Solutions are found for a particular geometry and a range of values of the vorticity. The method used to calculate the flow is an extension of a free-streamline method widely used in cases where the velocity is a constant on the separating streamline. Author

A84-42248#

FLAT SPIN OF CIRCULAR CYLINDERS INDUCED BY ARTIFICIAL ROUGHNESS

T. YOSHINAGA, A. TATE, and K. INOUE (National Aerospace Laboratory, Chofu, Tokyo, Japan) *Journal of Spacecraft and Rockets* (ISSN 0002-4650), vol. 21, July-Aug. 1984, p. 411-413. refs

The problem of the artificial transition of a boundary layer over a cylinder is considered, and a quasi-two-dimensional model of the flat spin moment of the cylinder is evaluated experimentally. A large model cylinder (200 mm diam) was supported by steel wires parallel to the freestream inside a wind tunnel. Rotational velocity was measured by counting the number of pulses produced as the model crossed a He-Ne laser beam. The rotational velocity of the cylinder is found to be greater than the rate predicted by the quasi-two-dimensional model of Yoshinaga, Tate and Inoue (1982). Some distinctive aspects of the three-dimensional effects observed in the experiment are described. I.H.

A84-42249#

REYNOLDS NUMBER EFFECTS ON THE AERODYNAMICS OF A BODY WITH SQUARE CROSS-SECTION

D. C. DANIEL (USAF, Armament Laboratory, Eglin AFB, FL), G. J. ZOLLARS, and T. R. YECHOUT (U.S. Air Force Academy, Colorado Springs, CO) *Journal of Spacecraft and Rockets* (ISSN 0002-4650), vol. 21, July-Aug. 1984, p. 413, 414. refs

Experimental results showing the effects of Reynolds number on the normal force and rolling moment of a body with square cross section are presented. The normal force results are similar in trend to results for circular cross section bodies. The observed

magnitude and Reynolds number effect is a strong function of roll orientation. The rolling moment for a finned vehicle of square cross section is shown to vary significantly with Reynolds number. C.D.

A84-42332#

TRANSIENT AERODYNAMIC CHARACTERISTICS OF A TWO-DIMENSIONAL LOW-SPEED WING AT SEVERAL ANGLES OF ATTACK

Y. AIHARA, H. KOYAMA (Tokyo, University, Tokyo, Japan), and A. MURASHIGE IN: *Atmospheric Flight Mechanics Conference*, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 71-79. refs

(AIAA PAPER 84-2076)

Attention is given to the transient aerodynamic characteristics of a two-dimensional, low speed wing whose response to impulsive angle-of-attack variations is studied experimentally. It is noted that, as the rise time T becomes shorter, transient aerodynamic characteristics deviate from quasi-steadiness. In the case where the ultimate angle-of-attack is sufficiently smaller than the static stall angle, lift first becomes greater than the static value and is then followed by sudden stalling. A nose-up pitching moment develops simultaneously, and the wing exhibits an instability that corresponds to the Wagner function of potential theory. O.C.

A84-42333#

EFFECT OF KARMAN VORTEX SHEDDING ON DYNAMIC STALL

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: *Atmospheric Flight Mechanics Conference*, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 80-87. refs

(AIAA PAPER 84-2077)

At high frequency oscillations, such as those occurring during stall flutter, Karman vortex shedding starts interacting strongly with the dynamic stall process. A simple analysis is presented which shows that the Karman vortex shedding has a damping effect when the airfoil oscillates faster than the so-called Strouhal frequency. This provides the high frequency boundary of the stall flutter region. Author

A84-42334#

AN APPROXIMATE ANALYSIS OF VORTEX BREAKDOWN

M. HANIN (Technion - Israel Institute of Technology, Haifa, Israel) IN: *Atmospheric Flight Mechanics Conference*, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 88-93. refs

(AIAA PAPER 84-2078)

The flow in the core of a vortex, and in particular the rapid deceleration leading to vortex breakdown, are studied analytically by an approximate method. An equation for the variation of velocity along the vortex core is deduced from the equations of steady axisymmetric inviscid flow using assumed radial profiles. Explicit solutions are obtained, and it is found that under certain conditions the calculated velocity on the axis decreases rapidly along the vortex and becomes zero, so that an internal stagnation-point flow and a separation bubble are formed. Thus the analysis gives a description and explanation of the essential feature of vortex breakdown. The predicted velocity variations and distances to stagnation point are found to agree fairly with experimental data. Author

02 AERODYNAMICS

A84-42335*# Technion - Israel Inst. of Tech., Haifa.
MODELING OF THE AERODYNAMIC RESPONSE TO
ARBITRARY AIRCRAFT MANEUVERES - A NUMERICAL
VALIDATION

J. KATZ (Technion - Israel Institute of Technology, Haifa, Israel) and L. B. SCHIFF (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 94-104. refs (AIAA PAPER 84-2079)

The regime of validity of an aerodynamic mathematical model, applicable to describe the nonlinear aerodynamic reactions to a delta wing maneuvering at high angles of attack is investigated. An unsteady vortex-lattice method is used to compute the unsteady flowfields, and thus to evaluate the aerodynamic data required by the model, in terms of specified characteristic motions. Time-histories of the aerodynamic responses to complex motions are generated by means of the model and the evaluated aerodynamic data, and are compared with baseline aerodynamic responses obtained from direct vortex-lattice computations. The validity of the mathematical modeling approach for the maneuvering delta wing is demonstrated by the close agreement of the force and moment responses obtained from the two approaches.

Author

A84-42343#
FLUID DYNAMICS OF AIRFOILS WITH CIRCULATION
CONTROL FOR V/STOL APPLICATION

F. MOKHTARIAN and V. J. MODI (British Columbia, University, Vancouver, Canada) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 167-175. Sponsorship: Natural Sciences and Engineering Research Council of Canada. refs (Contract NSERC-A-2181) (AIAA PAPER 84-2090)

The concept of moving surface boundary layer control as applied to an airfoil, with the leading edge comprising of a rotating cylinder, is studied using analytical, numerical and experimental approaches. Results of the analyses and test program, confined to the subcritical flow, suggest that: (1) the potential flow model of the conformal transformation, although it predicts correct trends, should be considered qualitative in character; (2) the numerical surface singularity approach appears to be promising. It can be extended to account for velocity, multielement configurations and wall confinement effects; and (3) the concept of moving surface boundary layer control is sound and quite effective. The tests with NACA 63-218 modified airfoil resulted in an increase in the maximum lift coefficient by around 200 percent for a surface to free stream speed ratio of 3 and the associated delay in stall angle to 45 deg.

Author

A84-42344#
AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC
CHARACTERISTICS OF BODIES HAVING SQUARE
CROSS-SECTION AT TRANSONIC SPEEDS

A. SIGAL (Technion - Israel Institute of Technology, Haifa, Israel) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 176-185. Research supported by the Technion - Israel Institute of Technology. refs (AIAA PAPER 84-2091)

Results of the present transonic wind tunnel tests on a square cross section modular body are compared with those of a dimensionally matching, circular cross section model. Mach number transients in the 0.5-1.06 range are used to obtain axial force data, and normal force characteristics were measured at Mach numbers of 0.75, 0.90, and 1.06 for angles of attack of -4 to 14 deg. The two families of models indicate that boat-tail geometry has a significant effect on the buildup of the nonlinear contribution to the normal force. This is suggested to be due to the adverse pressure gradient associated with the boat-tails, which enhances flow separation.

O.C.

A84-42345*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

COMPUTATIONAL-EXPERIMENTAL PRESSURE
DISTRIBUTIONS ON A TRANSONIC, LOW-ASPECT-RATIO
WING

E. R. KEENER (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 186-197. refs (AIAA PAPER 84-2092)

A generic, transonic, supercritical, low aspect-ratio wing was tested at design incidence of 5 deg at Mach numbers from 0.25 to 0.96. Oil-flow studies at the design Mach number of 0.85 showed local-flow separation, which, in retrospect, might have been avoided. At Mach 0.82 with unseparated flow, the surface-flow angles were less than 10 deg. Predictions with the FLO22 transonic potential code are good. Lift interference is strong without tunnel-wall suction. Evidence from this study shows that wings that are optimized for mild shock waves and pressure-recovery gradients generally have small, three-dimensional flow at conditions for unseparated flow.

Author

A84-42349#
INTERFERENCE EFFECTS BETWEEN SPHERICALLY BLUNTED
CYLINDERS AT M = 2.5 AND 1.5

D. R. PHILPOTT (Hatfield Polytechnic, Hatfield, Herts., England) and J. Z. ZHAO (Beijing Aerodynamics Institute, Beijing, People's Republic of China) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 231-239. Research supported by the Ministry of Defence (Procurement Executive). refs (AIAA PAPER 84-2098)

Surface pressure distributions, surface oil film patterns and schlieren photographs were examined for a pair of hemispherically blunted cylinders in close proximity at a free stream Mach number of 2.5 with some additional tests at a Mach number of 1.5. The relative longitudinal and lateral spacings of the cylinders were varied and the bow shock interactions classified according to Edney's system and some additional interaction types identified. Each interaction type was examined using pressure/deflection diagrams and a simple prediction technique, based on this principle, applied to some cases. The intersection region between the bow shock wave generated by one body and the afterbody of its neighbor was also examined.

Author

A84-42350#
CONE-DERIVED WAVERIDERS WITH LONGITUDINAL
CURVATURE

M. L. RASMUSSEN (Oklahoma, University, Norman, OK) and L. W. CLEMENT IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 240-249. refs (AIAA PAPER 84-2100)

Lifting-body waverider configurations with longitudinal curvature are derived by means of known flow fields past ogival bodies. The flow fields are generated by means of perturbations of the supersonic flow past a circular cone. Approximate analytic solutions for the shock-layer flow field are found within the framework of hypersonic small-disturbance theory. Perturbations due to longitudinal curvature produce reduced drag, increased lift-to-drag ratios, and provide design advantages for a more efficient volume distribution related to packaging of guidance, propulsion, and payload units.

Author

A84-42351#

ACTIVE CONTROL OF ASYMMETRIC VORTEX EFFECTS IN CIRCULAR CYLINDER

T. ABE and K. FUNABIKI (Tokyo, University, Tokyo, Japan) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 250-257. refs (AIAA PAPER 84-2101)

The low speed wind tunnel investigations for the anomalous side force acting on slender body at high angles of attack are conducted at Reynolds number of 110,000-480,000. Effects of geometrical configurations of the model and free stream Reynolds number are studied by measuring the aerodynamic force. Anomalous side force, which appears on the simple circular cylinder, is reduced by the attachment of the cone on the side end of the cylinder, although attachment of another cone on the other side increases the anomalous side force up to the level of the simple cylinder. The anomalous side force can be alleviated by attachment of the antennas around the cylinder. The antennas work as a surface roughness and promote the early transition of the boundary layer to the turbulent one. Author

A84-42358*# Air Force Armament Lab., Eglin AFB, Fla.

COMPARISON OF VARIOUS DRAG COEFFICIENT EXPANSIONS USING POLYNOMIALS AND SPLINES

S. M. SABOT, G. L. WINCHENBACH (USAF, Armament Laboratory, Eglin AFB, FL), and G. T. CHAPMAN (NASA, Ames Research Center, Thermo- and Gas Dynamics Div., Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 334-340. refs (AIAA PAPER 84-2113)

The longitudinal differential equation of motion has been used to investigate various aerodynamic expansion techniques. The total drag coefficient was expanded using conventional polynomials and splines with and without floating knot locations. This paper discusses the various techniques and approaches, compares results obtained from simultaneously fitting four separate flights (time vs distance measurements) and outlines the potential advantages and/or disadvantages of the various aerodynamic expansion techniques. It is believed that this is the first time splines have been used in the aerodynamic coefficient estimation process and that these results and techniques are germane to other applications. Author

A84-42359#

CALCULATIONS OF VISCOUS SUPERSONIC FLOW OVER FINNED BODIES USING A 'THIN-FIN' APPROXIMATION

R. U. JETTMAR (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 341-347. Navy-supported research. refs (AIAA PAPER 84-2114)

The focus of the present study is the development of a numerical technique for treating bodies with thin, sharp fins. Instead of considering the cross-sectional body-fin geometry as a single entity, the present method considers the body alone and the fin geometries separately. The computational grid is generated using normalizing transformations applied to the body alone configuration. The fin surfaces are allowed to extend into the computational region. Numerical results are presented and demonstrate the applicability of the PNS model in conjunction with a 'branch-cut' grid to complex wing-body configurations. Author

A84-42361*# Air Force Armament Lab., Eglin AFB, Fla.

AN EVALUATION OF A PARABOLIZED NAVIER-STOKES (PNS) CODE FOR CONE-CYLINDER-FLARED CONFIGURATIONS

C. J. COTTRELL (USAF, Armament Laboratory, Eglin AFB, FL) and G. T. CHAPMAN (NASA, Ames Research Center, Thermo- and Gas Dynamics Div., Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 359-367. refs (AIAA PAPER 84-2116)

A PNS code's capability to predict the onset of laminar and turbulent boundary layer separation, forces, moments, and pressure distributions was investigated. Predictions of incipient separation show good agreement with experimental results. Force and moment calculations were found to agree favorably with experimental data for a wide range of geometries for Mach numbers from 2 to 4 with turbulent boundary layers. Limited comparison of pressure distribution data also showed good agreement. Skin friction and Stanton number calculations are presented to indicate the code's capability to calculate this information and hence, provide a complete data base for attached flow conditions. The sensitivity of these calculations to smoothing and marching parameter variations was examined and found to be acceptable for most design work. The code was found to be suitable to complement or reduce wind tunnel experimentation for the design of this class of configuration with regard to accuracy, cost and usability. Author

A84-42362#

PNS COMPUTATIONS FOR SPINNING AND FIN-STABILIZED PROJECTILES AT SUPERSONIC VELOCITIES

P. WEINACHT, B. J. GUIDOS, L. D. KAYSER, and W. B. STUREK (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, MD) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 378-388. refs (AIAA PAPER 84-2118)

The parabolized Navier-Stokes (PNS) computational technique has been applied to calculate the three-dimensional viscous flow about a standard spinning projectile and a long L/D finned projectile. The results for the spinning projectile are compared with past PNS computations and wind tunnel pressure and force measurements in order to benchmark the updated version of the code. Excellent agreement is found and the improvements to the code are shown to provide greater computational efficiency. Results are then presented for the finned projectile configuration and comparison made with predictions from an inviscid code and an experimental data base. Author

A84-42363*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

EXPERIMENTAL HEATING DISTRIBUTIONS FOR BICONICS AT INCIDENCE IN MACH 10 AIR AND COMPARISON TO PREDICTION

C. G. MILLER, P. A. GNOFFO, and S. E. WILDER (NASA, Langley Research Center, Space Systems Div., Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 389-401. refs (AIAA PAPER 84-2119)

Heating distributions were measured on a 1.9 percent scale model of a generic, aeroassisted vehicle proposed for missions to a number of planets and also a candidate as a moderate L/D earth orbital transfer vehicle. This vehicle is a spherically blunted, 13 deg/7 deg biconic with the fore-cone bent upward 7 deg to provide self-trim capability; also tested was a straight biconic with the same nose radius and half angles. These measurements were made in the Langley 31-Inch Mach 10 Tunnel at values of the free-stream Reynolds number, based on model length, equal to 0.2 and 0.9 million. The angle of attack, referenced to the aft cone, was varied from 0 to 20 deg. Heating distributions predicted with a parabolized Navier Stokes (PNS) code are compared to

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measurement over the present range of Reynolds number and angle of attack. Windward heating was predicted to within 10 percent by the PNS code. Leeward heating distributions were predicted qualitatively for both values of Reynolds number, but quantitative agreement was poorer than on the windward side.

Author

A84-42365#

EFFECT OF VEHICLE DYNAMICS ON SLENDER CONE TRANSITION

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 414-423. refs

(AIAA PAPER 84-2124)

The well-documented coupling existing between body motion and boundary layer transition on slender vehicles is examined to see if it can explain the experimentally observed anomaly that transition occurs earlier in a quiet ballistic range than in a noisy wind tunnel. It is found that the so-called moving wall effects, present for the free flying model, could cause the early boundary layer transition and could also explain the measured effect of unit Reynolds number in a ballistic range.

Author

A84-42373*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE AERODYNAMICS OF SOME GUIDED PROJECTILES

M. L. SPEARMAN (NASA, Langley Research Center, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 484-489. refs

(AIAA PAPER 84-2097)

Some characteristic projectile shapes are considered with various added components intended to provide lift, stability, and control. The intent of the additions is to provide some means for altering the normal ballistic flight path of a projectile for various purposes such as: achieving greater accuracy at the impact point, selecting alternate impact points, extending range, improved evasion, and so on. The configurations presented illustrate the effects of a flare, wings, and tails for providing stability and lift, and the effects of aft-tails, a close-coupled flap, and all-moving forward wings for control. The relative merits of the various configurations, all of which provided for flight path alterations, are discussed.

Author

A84-42374#

INVISCID MULTIPLE ZONE CALCULATIONS FOR SUPERSONIC TACTICAL MISSILES

A. B. WARDLAW, JR., F. J. PRIOLO, J. M. SOLOMON, and F. P. BALTAKIS (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 490-499. Navy-supported research. refs

(AIAA PAPER 84-2099)

A computational method applicable to finned bodies in supersonic flight is described. The cross-sectional geometry is treated using a multiple zone approach. This entails breaking the crossflow plane into a number of different zones, each of which can be described using a simple mapping. The edges of the zones are chosen to coincide with fin, body or shock surfaces. The resulting algorithm is applicable to a wide range of configurations including interior as well as exterior supersonic flow fields. Leading and trailing edges are described using a local analysis which is exact in the case of supersonic conditions. Calculations are compared to experiment and another computational method for several different missile shapes.

Author

A84-42478

THE INCOMPRESSIBLE FLOW AT THE STAGNATION POINT OF SLENDER BODIES [DIE INKOMPRESSIBLE STROEMUNG AM STAUPUNKT SCHLANKER KOERPER]

K. OSWATITSCH (Wien, Technische Universitaet, Vienna, Austria) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 64, no. 6, 1984, p. 201-210. In German. refs

The present investigation is concerned with steady incompressible potential flow. An imperfection of the currently employed theories for noninclined slender profiles, wings, and axisymmetric bodies is pointed out. Simplified boundary conditions lead to logarithmic singularities for the velocity and a 'stagnation point error'. It is thought to be unsatisfactory that the stagnation point is not correctly represented in a theory of slender bodies. The current investigation has, therefore, the objective to eliminate this defect of the theory. In the obtained correct solution, the logarithm is replaced by a power of the distance from the stagnation point or the edge, taking into account a very small exponent. A known mathematical approximation regarding the relation between this power and the logarithm provides an explanation for the quality of the 'classical approximation' in the immediate vicinity of the singularity.

G.R.

A84-42526

DETERMINATION OF THE PARAMETERS OF A BOUNDARY LAYER ON A ROTATING AXISYMMETRIC CONE [OPREDELENIE PARAMETROV POGRANICHNOGO SLOIA NA VRASHCHAIUSHCHIKHSIA OSESIMMETRICHNYKH KONUSAKH]

A. N. POKROVSKII, V. N. SHMANENKOV, and V. M. SHCHUCHINOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1984, p. 34-39. In Russian. refs

A method is proposed for solving the three-dimensional equations of laminar and turbulent boundary layers on a sharp rotating axisymmetric cone flying at angle of attack. The properties of the solutions obtained are examined, and a comparison is made with previous results. The findings indicate the limits of the applicability of linear theory and demonstrate the conservative character of the flow in the turbulent boundary layer on a rotating cone.

B.J.

A84-42533

LOCAL VISCOUS CHEMICALLY NONEQUILIBRIUM FLOWS [O LOKAL'NYKH VIAZKIKH KHIMICHESKI NERAVNOVESNYKH TECHENIIAKH]

V. V. BOGOLEPOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1984, p. 137-144. In Russian. refs

A theoretical investigation of supersonic chemically nonequilibrium flow in local regions near the cold surfaces of bodies is presented. It is shown that the chemical reactions can occur only on the catalytic surface and that the gas can be assumed to be a binary mixture of atoms and molecules. As an example, consideration is given to the aerodynamic heating of a small protuberance on the plate surface in the case when the flow past this protuberance is described by the Navier-Stokes equations for an incompressible gas as the Reynolds number tends to infinity. The presence of the protuberance is shown to increase the drag of this part of the body: for a noncatalytic surface this results in additional heating, while for a catalytic surface this reduces the catalytic effect and therefore diminishes the heating of the protuberance.

B.J.

A84-42535

INVESTIGATION OF HYPERSONIC RAREFIED-GAS FLOW PAST WINGS OF INFINITE SPAN [K ISSLEDOVANIU OBTEKANIIA KRYL'EV BESKONECHNOGO RAZMAKHA GIPERZVUKOVYM POTOKOM RAZREZHENNOGO GAZA]

E. A. GERSHBEIN and V. G. SHCHERBAK Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1984, p. 150-154. In Russian. refs

The local-self-similar approximation to the Navier-Stokes equations is used to investigate the flow of an inhomogeneous gas in a hypersonic viscous shock layer on wings of infinite span with a blunt leading edge. Attention is given to the region near the stagnation line; and boundary conditions taking into account gas injection or suction are specified on the surface of the body and in the undisturbed flow. A numerical solution is obtained in a wide range of Reynolds numbers, injection or suction parameter, and slip angle. B.J.

A84-42536

CONTOURING OF TWO-DIMENSIONAL AND AXISYMMETRIC SUPERSONIC CHANNELS REALIZING DISCONTINUOUS PARAMETERS AT THE OUTLET AND FLOW LEVELING [O PROFILIROVANII PLOSKIKH I OSESIMMETRICHNYKH SVERKHZVUKOVYKH KANALOV, REALIZIUIUSHCHIKH RAZRYVNYE PARAMETRY NA VYKHODE I VYRAVNIIVANIE POTOKA]

A. S. VOINOVSKII, V. I. KIREEV, S. N. MININ, U. G. PIRUMOV, and S. S. SMIRNOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1984, p. 155-159. In Russian. refs

Two classes of supersonic channels are examined. One class realizes specified discontinuous distributions of entropy and pressure (p) or angle of inclination (theta) of the velocity vector to the x axis at the outlet; while the other class transforms a flow with discontinuous distribution of gasdynamic parameters to a flow that is homogeneous with respect to p and theta. Schemes for the contouring of these classes of channels are proposed, and calculations are made with the classical method of characteristics and its layer modifications. B.J.

A84-42540

EFFECT OF BODY ROTATION AND OUTER VORTICITY ON HEAT TRANSFER NEAR THE STAGNATION POINT OF A BLUNT BODY IN A SUPERSONIC FLOW [O VLIIANII VRASHCHENIIA TELA I VNESHNEI ZAVIKHRENNOSTI NA TEPLOOBMEN OKOLO KRITICHESKOI TOCHKI ZATUPLENNNOGO TELA V SVERKHZVUKOVOM POTOKE]

A. A. MARKOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1984, p. 179-182. In Russian.

An analysis is made of the effect of a longitudinal vortex Omega on the hypersonic viscous shock layer near a cooled axisymmetric surface rotating about the longitudinal axis with an angular velocity Omega sub 1. The theory of a thin three-dimensional shock layer is used to simplify the viscous-shock-layer equations for the neighborhood of the stagnation point. Calculations are presented for the effect of Omega and Omega sub 1 on heat transfer and the structure of the shock layer in the case of steady flow. An iterative method is used, and a modification is proposed which speeds up the convergence. Characteristic intervals of the variation of Omega and Omega sub 1, dependent on Mach and Reynolds numbers, are indicated for which the distributions of streamlines in the shock layer have qualitatively different characters. B.J.

A84-42542

VARIATION OF THE PARAMETERS OF A SUPERSONIC FLOW WITH TRANSVERSE INJECTION [IZMENENIE PARAMETROV SVERKHZVUKOVOGO POTOKA PRI POPERECHNOM VDUVE]

V. A. VOLKOV, A. P. ZUEV, N. N. OSTROUKHOV, and B. K. TKACHENKO Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1984, p. 188-192. In Russian.

Consideration is given to the flow developing in a supersonic nozzle in the case of the injection of a transverse gas jet into an expanding supersonic stream. Measurements of the total and static pressures of the flow in several sections of the nozzle are made. It is shown that two flow regimes differing in the dependence of Mach number of alpha (angle of attack) exist depending on the relative flowrate of the injected gas. At low values of alpha, the experimental values of the flow parameters agree satisfactorily with those calculated on the basis of a one-dimensional model with a narrow mixing layer near the injection section. B.J.

A84-42554

HYPERSONIC FLOW PAST A DELTA WING AT LARGE ANGLES OF ATTACK [OBTEKANIE TREVOL'NOGO KRYLA GIPERZVUKOVYM POTOKOM PRI BOL'SHIKH UGLAKH ATAKI]

V. N. GOLUBKIN Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 48, May-June 1984, p. 376-382. In Russian. refs

The thin-shock-layer method is used to study the hypersonic flow past a delta wing of finite span at angles of attack close to $\pi/2$. Analytical expressions are obtained for the gasdynamic functions and equations connecting the form of the wing surface and the shock, and a method is proposed for solving inverse problems of the flow past thin wings with attached shocks. For epsilon (the ratio of densities on the shock) much less than 1, there exists a flow regime in the range of attack angles close to $\pi/2$, $\alpha = \pi/2 - \epsilon \exp 1/2 A$; here the shock is attached to or detached from the wing apex, but it can be attached to or detached from the leading edge depending on the sweep angle. B.J.

A84-42570

OSCILLATING AIRFOILS AND THEIR WAKE [SCHWINGENDE TRAGFLAECHEN UND IHR NACHLAUF]

W. SEND (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) DFVLR-Nachrichten (ISSN 0011-4901), vol. 42, June 1984, p. 13-18. In German.

The unsteady phenomena in the wake of an oscillating wing or rotor blade are examined theoretically using the Prandtl approximation of the vortex-transport equation. A mathematical model is developed and applied to such problems as the effect of winglets on the performance of fixed wings and the possibility of employing similar designs in rotor blades. Model predictions for several profiles are compared with published experimental measurements, and good agreement is found. Graphs and diagrams are provided. T.K.

N84-28732* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SHAPES FOR ROTATING AIRFOILS Patent

G. J. BINGHAM, inventor (to NASA) 10 Jul. 1984 12 p Filed 6 Mar. 1979 Supersedes N79-24958 (17 - 16, p 2070) (NASA-CASE-LAR-12396-1; US-PATENT-4,459,083; US-PATENT-APPL-SN-017889; US-PATENT-CLASS-416-223R; US-PATENT-CLASS-416-242; US-PATENT-CLASS-244-35R) Avail: US Patent and Trademark Office CSCL 01A

An airfoil which has particular application to the blade or blades of rotor aircraft and aircraft propellers is presented. The airfoil thickness distribution, camber and leading edge radius are shaped to locate the airfoil crest at a more aft position along the chord, and to increase the freestream Mach number at which sonic flow is attained at the airfoil crest. The reduced slope of the airfoil causes a reduction in velocity at the airfoil crest at lift coefficients

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from zero to the maximum lift coefficient. The leading edge radius is adjusted so that the maximum local Mach number at 1.25 percent chord and at the designed maximum lift coefficient is limited to about 0.48 when the Mach number normal to the leading edge is approximately 0.20. The lower surface leading edge radius is shaped so that the maximum local Mach number at the leading edge is limited to about 0.29 when the Mach number normal to the leading edge is approximately 0.20. The drag divergence Mach number associated with the airfoil is moved to a higher Mach number over a range of lift coefficients resulting in superior aircraft performance.

Official Gazette of the U.S. Patent and Trademark Office

N84-28734*# New York Univ., New York.

STUDY OF TRANSONIC FLOW OVER SWEEPED WINGS Final Technical Report Abstract Only

1983 3 p

(Contract NGR-33-016-201)

(NASA-CR-173799; NAS 1.26:173799) Avail: NTIS HC A02/MF A01 CSCL 01A

The design of shockless airfoils that are appropriate for experimental work on a supersonic transport with an oblique wing are examined. A series of computer codes for the design and analysis of airfoils and wings in two dimensional and three dimensional transonic flow are studied. The oblique wing 3-D code was the forerunner of the later swept wing code. Techniques to incorporate the effect of an engine or fuselage in the inverse design code while using a minimum of computer resources are developed.

M.A.C.

N84-28735*# Douglas Aircraft Co., Inc., Long Beach, Calif.

RESULTS OF DESIGN STUDIES AND WIND TUNNEL TESTS OF HIGH-ASPECT-RATIO SUPERCritical WINGS FOR AN ENERGY EFFICIENT TRANSPORT

D. K. STECKEL, J. A. DAHLIN, and P. A. HENNE Hampton, Va. NASA. Langley Research Center Oct. 1980 174 p refs (Contract NAS1-14744)

(NASA-CR-159332; NAS 1.26:159332; ACEE-06-FR-9894) Avail: NTIS HC A08/MF A01 CSCL 01A

These basic characteristics of critical wings included wing area, aspect ratio, average thickness, and sweep as well as practical constraints on the planform and thickness near the wing root to allow for the landing gear. Within these constraints, a large matrix of wing designs was studied with spanwise variations in the types of airfoils and distribution of lift as well as some small planform changes. The criteria by which the five candidate wings were chosen for testing were the cruise and buffet characteristics in the transonic regime and the compatibility of the design with low speed (high-lift) requirements. Five wing-wide-body configurations were tested in the NASA Ames 11-foot transonic wind tunnel. Nacelles and pylons, flap support fairings, tail surfaces, and an outboard aileron were also tested on selected configurations.

Author

N84-28736*# Wichita State Univ., Kans.

EXPERIMENTAL STUDIES OF FLOW SEPARATION OF THREE AIRFOILS AT LOW SPEEDS Final Report

E. J. RODGERS, H. C. SEETHARAM, and W. H. WENTZ, JR. Washington NASA Mar. 1982 163 p (Contract NGR-17-003-021)

(NASA-CR-3530; NAS 1.26:3530; AR-79-2) Avail: NTIS HC A08/MF A01 CSCL 01A

Wind tunnel tests were conducted on the NASA LS(1)-0421 Mod, NACA 2412 and NASA GA(W)-2 airfoil sections at a Reynolds number of 2.2×10^6 and a Mach number of 0.13. Detailed measurements of flow fields associated with turbulent boundary layers of these airfoils were obtained at pre-stall, near-stall, and post-stall angles of attack. Velocity and pressure survey results over the airfoil and in the associated wake, are presented for fully attached flow conditions through the stalled flow condition. Extensive force, pressure, tuft survey, hot-film survey, local skin friction and boundary layer data are also included.

M.G.

N84-28737*# Vought Corp., Dallas, Tex.

STUDY OF AERODYNAMIC TECHNOLOGY FOR SINGLE-CRUISE ENGINE V/STOL FIGHTER/ATTACK AIRCRAFT Final Report, Jun. 1981 - Feb. 1982

H. H. DRIGGERS, S. A. POWERS, and R. T. ROUSH Feb. 1982 208 p refs

(Contract NAS2-11003)

(NASA-CR-166271; NAS 1.26:166271; REPT-2-52300/2R-53020)

Avail: NTIS HC A10/MF A01 CSCL 01A

A conceptual design analysis is performed on a single engine V/STOL supersonic fighter/attack concept powered by a series flow tandem fan propulsion system. Forward and aft mounted fans have independent flow paths for V/STOL operation and series flow in high speed flight. Mission, combat and V/STOL performance is calculated. Detailed aerodynamic estimates are made and aerodynamic uncertainties associated with the configuration and estimation methods identified. A wind tunnel research program is developed to resolve principal uncertainties and establish a data base for the baseline configuration and parametric variations.

M.A.C.

N84-28738*# Rockwell International Corp., Columbus, Ohio.

STUDY OF AERODYNAMIC TECHNOLOGY FOR SINGLE-CRUISE-ENGINE V/STOL FIGHTER/ATTACK AIRCRAFT Final Report, Jun. 1981 - Feb. 1982

L. MARK Feb. 1982 236 p refs Sponsored in part by Naval Ship Research and Development Center and Naval Air Systems Command

(Contract NAS2-11002)

(NASA-CR-166270; NAS 1.26:166270; NR81H-100) Avail: NTIS HC A11/MF A01 CSCL 01A

Conceptual designs and analyses were conducted on two V/STOL supersonic fighter/attack aircraft. These aircraft feature low footprint temperature and pressure thrust augmenting ejectors in the wings for vertical lift, combined with a low wing loading, low wave drag airframe for outstanding cruise and supersonic performance. Aerodynamic, propulsion, performance, and mass properties were determined and are presented for each aircraft. Aerodynamic and Aero/Propulsion characteristics having the most significant effect on the success of the 'up' and 'away' flight mode were identified, and the certainty with which they could be predicted was defined. A wind tunnel model and test program are recommended to resolve the identified uncertainties.

Author

N84-28739*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PRESSURE DISTRIBUTION DATA FROM TESTS OF 2.29-METER (7.5-FT.) SPAN EET HIGH-LIFT RESEARCH MODEL IN LANGLEY 4- BY 7-METER TUNNEL

H. L. MORGAN, JR. Jun. 1982 541 p

(NASA-TM-83111; NAS 1.15:83111) Avail: NTIS HC A23/MF A01 CSCL 01A

A 2.29 m (7.5 ft.) span high-lift research model equipped with full-span leading-edge slat and part-span double-slotted trailing-edge flap was tested in the Langley 4- by 7-Meter Tunnel to determine the low speed performance characteristics of a representative high aspect ratio supercritical wing. These tests were performed in support of the Energy Efficient Transport (EET) program which is one element of the Aircraft Energy Efficiency (ACEE) project. Static longitudinal forces and moments and chordwise pressure distributions at three spanwise stations were measured for cruise, climb, two take-off flap, and two landing flap wing configurations. The tabulated and plotted pressure distribution data is presented without analysis or discussion.

Author

N84-28740*# Old Dominion Univ., Norfolk, Va.
COMPUTER PROGRAM DOCUMENTATION FOR A SUBCRITICAL WING DESIGN CODE USING HIGHER ORDER FAR-FIELD DRAG MINIMIZATION Contractor Report, 1 Sep. 1979 - 31 Aug. 1980

J. M. KUHLMAN and J. Y. SHU Washington NASA Sep. 1981 173 p

(Contract NSG-1357)

(NASA-CR-3457; NAS 1.26:3457) Avail: NTIS HC A08/MF A01 CSCL 01A

A subsonic, linearized aerodynamic theory, wing design program for one or two planforms was developed which uses a vortex lattice near field model and a higher order panel method in the far field. The theoretical development of the wake model and its implementation in the vortex lattice design code are summarized and sample results are given. Detailed program usage instructions, sample input and output data, and a program listing are presented in the Appendixes. The far field wake model assumes a wake vortex sheet whose strength varies piecewise linearly in the spanwise direction. From this model analytical expressions for lift coefficient, induced drag coefficient, pitching moment coefficient, and bending moment coefficient were developed. From these relationships a direct optimization scheme is used to determine the optimum wake vorticity distribution for minimum induced drag, subject to constraints on lift, and pitching or bending moment. Integration spanwise yields the bound circulation, which is interpolated in the near field vortex lattice to obtain the design camber surface(s). Author

N84-28741*# Boeing Military Airplane Development, Seattle, Wash.

PAN AIR SUMMARY DOCUMENT (VERSION 1.0) Contractor Report, Jan. 1978 - Dec. 1981

T. DERBYSHIRE and K. W. SIDWELL Washington NASA Apr. 1982 49 p refs Sponsored in cooperation with ASD, AFWAL, and Naval Coastal Systems Center

(Contract NAS2-9830)

(NASA-CR-3250; NAS 1.26:3250; D180-24910-1) Avail: NTIS HC A03/MF A01 CSCL 01A

The capabilities and limitations of the panel aerodynamics (PAN AIR) computer program system are summarized. This program uses a higher order panel method to solve boundary value problems involving the Prandtl-Glauert equation for subsonic and supersonic potential flows. Both aerodynamic and hydrodynamic problems can be solved using this modular software which is written for the CDC 6600 and 7600, and the CYBER 170 series computers.

A.R.H.

N84-28742*# Douglas Aircraft Co., Inc., Long Beach, Calif.
WIND TUNNEL TESTS OF HIGH-LIFT SYSTEMS FOR ADVANCED TRANSPORTS USING HIGH-ASPECT-RATIO SUPERCRITICAL WINGS Final Report

J. B. ALLEN, W. R. OLIVER, and L. A. SPACHT Washington NASA Jul. 1982 181 p refs

(Contract NAS1-15327)

(NASA-CR-3523; NAS 1.26:3523; ACEE-17-FR-1608) Avail:

NTIS HC A09/MF A01 CSCL 01A

The wind tunnel testing of an advanced technology high lift system for a wide body and a narrow body transport incorporating high aspect ratio supercritical wings is described. This testing has added to the very limited low speed high Reynolds number data base for this class of aircraft. The experimental results include the effects on low speed aerodynamic characteristics of various leading and trailing edge devices, nacelles and pylons, ailerons, and spoilers, and the effects of Mach and Reynolds numbers.

M.A.C.

N84-28743*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

TWO-DIMENSIONAL AERODYNAMIC CHARACTERISTICS OF THREE ROTORCRAFT AIRFOILS AT MACH NUMBERS FROM 0.35 TO 0.90

G. J. BINGHAM and K. W. NOONAN May 1982 73 p refs

(Contract DA PROJ. 1L1-61102-AH-45)

(NASA-TP-2000; L-14955; NAS 1.60:2000;

AVRADCOM-TR-82-B-2) Avail: NTIS HC A04/MF A01 CSCL 01A

Three airfoils designed for helicopter rotor application were investigated in the Langley 6- by 28-inch Transonic Tunnel to determine the two dimensional aerodynamic characteristics at Mach numbers from 0.34 to 0.88 and respective Reynolds numbers from about $4.4 \times 10(6)$ power to $9.5 \times 10(6)$ power. The airfoils have thickness-to-chord ratios of 0.08, 0.10, and 0.12. Trailing-edge reflex was applied to minimize pitching moment. The maximum normal-force coefficient of the RC(3)-12 airfoil is from 0.1 to 0.2 higher, depending on Mach number M, than that of the NACA 0012 airfoil tested in the same facility. The maximum normal-force coefficient of the RC(3)-10 is about equal to that of the NACA 0012 at Mach numbers to 0.40 and is higher than that of the NACA 0012 at Mach numbers above 0.40. The maximum normal force coefficient of the RC(3)-08 is about 0.19 lower than that of the NACA 0012 at a Mach number of 0.35 and about 0.05 lower at a Mach number of 0.54. The drag divergence Mach number of the RC(3)-08 airfoil at normal-force coefficients below 0.1 was indicated to be greater than the maximum test Mach number of 0.88. At zero lift, the drag-divergence Mach numbers of the RC(3)-12 and the RC(3)-10 are about 0.77 and 0.82, respectively.

Author

N84-28744# Cranfield Inst. of Tech., Bedfordshire (England). College of Aeronautics.

A RING SOURCE METHOD FOR PREDICTING THE AERODYNAMIC CHARACTERISTICS OF BODIES OF REVOLUTION

P. A. T. CHRISTOPHER, H. S. DEO, and C. T. SHAW Mar. 1984 56 p refs

(COA-8409; ISBN-0-947767-05-3) Avail: NTIS HC A04/MF A01

A method if presented for determining the potential flow around bodies of revolution at incidence and yaw in uniform flow, and in curvilinear flow. This method utilizes the ring source method of Hess and Smith and gives substantial advantage over existing techniques. When compared with the method of Petrie, in a typical case, the computer run time is almost halved. The method is applicable to a wide class of bodies, both pointed and blunt, and determines both surface and flow field conditions. By its nature it is, of course, limited to low total angles of attack. Author

N84-28745*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PRACTICAL ADAPTIVE-GRID METHOD FOR COMPLEX FLUID-FLOW PROBLEMS

K. NAKAHASHI and G. S. DEIWERT Jun. 1984 8 p refs

(NASA-TM-85989; A-9803; NAS 1.15:85989) Avail: NTIS HC

A02/MF A01 CSCL 01A

A practical solution, adaptive-grid method utilizing a tension and torsion spring analogy is proposed for multidimensional fluid flow problems. The tension spring, which connects adjacent grid points to each other, controls grid spacings. The torsion spring, which is attached to each grid node, controls inclinations of coordinate lines and grid skewness. A marching procedure was used that results in a simple tridiagonal system of equations at each coordinate line to determine grid-point distribution. Multidirectional adaptation is achieved by successive applications of one-dimensional adaptation. Examples of applications for axisymmetric afterbody flow fields and two dimensional transonic airfoil flow fields are shown. Author

02 AERODYNAMICS

N84-28746*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL SIMULATION OF BOUNDARY-LAYER TRANSITION

P. R. SPALART Jun. 1984 7 p refs
(NASA-TM-85984; A-9796; NAS 1.15:85984) Avail: NTIS HC A02/MF A01. CSCL 01A

The transition to turbulence in boundary layers was investigated by direct numerical solution of the nonlinear, three-dimensional, incompressible Navier-Stokes equations in the half-infinite domain over a flat plate. Periodicity was imposed in the streamwise and spanwise directions. A body force was applied to approximate the effect of a nonparallel mean flow. The numerical method was spectra, based on Fourier series and Jacobi polynomials, and used divergence-free basis functions. Extremely rapid convergence was obtained when solving the linear Orr-Sommerfeld equation. The early nonlinear and three-dimensional stages of transition, in a boundary layer disturbed by a vibrating ribbon, were successfully simulated. Excellent qualitative agreement was observed with either experiments or weakly nonlinear theories. In particular, the breakdown pattern was staggered or nonstaggered depending on the disturbance amplitude. Author

N84-28747*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CALCULATION OF UNSTEADY AERODYNAMICS FOR FOUR AGARD STANDARD AEROELASTIC CONFIGURATIONS

S. R. BLAND and D. A. SEIDEL May 1984 80 p refs
(NASA-TM-85817; NAS 1.15:85817) Avail: NTIS HC A05/MF A01 CSCL 01A

Calculated unsteady aerodynamic characteristics for four Advisory Group for Aeronautical Research Development (AGARD) standard aeroelastic two-dimensional airfoils and for one of the AGARD three-dimensional wings are reported. Calculations were made using the finite-difference codes XTRAN2L (two-dimensional flow) and XTRAN3S (three-dimensional flow) which solve the transonic small disturbance potential equations. Results are given for the 36 AGARD cases for the NACA 64A006, NACA 64A010, and NLR 7301 airfoils with experimental comparisons for most of these cases. Additionally, six of the MBB-A3 airfoil cases are included. Finally, results are given for three of the cases for the rectangular wing. Author

N84-28748*# Comtek, Grafton, Va.

A PRELIMINARY DESIGN STUDY ON AN ACOUSTIC MUFFLER FOR THE LAMINAR FLOW TRANSITION RESEARCH APPARATUS Final Report

A. L. ABRAHAMSON Jul. 1984 45 p refs
(Contract NAS1-17244)
(NASA-CR-172374; NAS 1.26:172374) Avail: NTIS HC A03/MF A01 CSCL 01A

An acoustic muffler design of a research tool for studying laminar flow and the mechanisms of transition, the Laminar Flow and Transition Research Apparatus (LFTRA) is investigated. Since the presence of acoustic pressure fluctuations is known to affect transition, low background noise levels in the test section of the LFTRA are mandatory. The difficulties and tradeoffs of various muffler design concepts are discussed and the most promising candidates are emphasized. M.A.C.

N84-28749*# Boeing Commercial Airplane Co., Seattle, Wash. **THREE-DIMENSIONAL TRANSONIC POTENTIAL FLOW ABOUT COMPLEX 3-DIMENSIONAL CONFIGURATIONS**

T. A. REYHNER Washington NASA Jul. 1984 76 p refs
Sponsored by NASA
(NASA-CR-3814; NAS 1.26:3814; D6-52329) Avail: NTIS HC A05/MF A01 CSCL 01A

An analysis has been developed and a computer code written to predict three-dimensional subsonic or transonic potential flow fields about lifting or nonlifting configurations. Possible configurations include inlets, nacelles, nacelles with ground planes, S-ducts, turboprop nacelles, wings, and wing-pylon-nacelle combinations. The solution of the full partial differential equation

for compressible potential flow written in terms of a velocity potential is obtained using finite differences, line relaxation, and multigrid. The analysis uses either a cylindrical or Cartesian coordinate system. The computational mesh is not body fitted. The analysis has been programmed in FORTRAN for both the CDC CYBER 203 and the CRAY-1 computers. Comparisons of computed results with experimental measurement are presented. Descriptions of the program input and output formats are included. Author

N84-28750*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A NUMERICAL SIMULATION OF THREE-DIMENSIONAL FLOW IN AN ADAPTIVE WALL WIND TUNNEL

J. P. MENDOZA Aug. 1984 36 p refs
(NASA-TP-2351; A-9622; NAS 1.60:2351) Avail: NTIS HC A03/MF A01 CSCL 01A

Numerical simulations of three dimensional flows in a prototype adaptive wall wind tunnel are conducted at the Mach number of 0.6 to investigate: (1) wind tunnel wall interference, (2) active streamline control by varying air removal or injection along the walls, and (3) to develop a method for establishing wall boundary conditions for interference free flows. Wind tunnel wall interference could be controlled by using only the vertical velocity components. For the configuration tested, interference free flow with solid sidewalls can be approximated by using only floor and ceiling blowing/suction. M.A.C.

N84-28751# Rockwell International Corp., Thousand Oaks, Calif.

STUDY OF ASYMPTOTIC THEORY OF TRANSONIC WIND TUNNEL WALL INTERFERENCE Final Report, 30 May 1982 - 30 Aug. 1983

N. D. MALMUTH and J. D. COLE Arnold AF Station, Tenn. AEDC May 1984 61 p
(Contract F40600-82-C-0005)
(AD-A141431; SC5332.6FR; AEDC-TR-84-8) Avail: NTIS HC A04/MF A01 CSCL 20D

Asymptotic procedures were considered for two limiting cases of wind-tunnel interference assessment on transonic models. The first corresponds to slender configurations representative of fighter aircraft, and the second is associated with high aspect ratio shapes related to bombers and transports. In the first instance, solid cylindrical walls of radius much greater than the chord lead to interference effects on the drag of a greater magnitude than the lift. A similarity law was discovered for this effect in which the normalized drag correction is proportional to the product of the blockage ratio, and a function of the free-stream and tunnel perturbation to the transonic similarity parameter. On the basis of this law, alterations to the similarity parameter can be sought to obtain interference-free conditions for the drag. In addition, the theory provides systematic means of extrapolating to zero model size. A numerical problem was formulated whose solution gives the structure of the interference flow field. For the high aspect ratio case associated with rectangular cross-section solid walls, asymptotic methods give a framework which is a generalization of lifting line theory for unconfined flows. Near the wing, the flow retains the two-dimensional strip theory character of the free-field situation. By contrast, the far field consists of a bound vortex, shedding trailing vorticity at a rate proportional to the spanwise gradient in the spanwise load distribution. GRA

N84-28752# Scientific Research Associates, Inc., Glastonbury, Conn.

INVESTIGATION OF THE MECHANISM OF TRANSONIC SHOCK WAVE/BOUNDARY LAYER INTERACTIONS USING A NAVIER-STOKES ANALYSIS Final Report, Jul. 1980 - May 1983

D. V. ROSCOE, S. J. SHAMROTH, H. J. GIBELING, and H. MCDONALD May 1984 89 p
(Contract DAAG29-80-C-0082)
(AD-A141551; SRA-R83-930006-F; ARO-17048.1-EG) Avail: NTIS HC A05/MF A01 CSCL 20D

The present report discusses the development of a time-dependent Navier-Stokes code for use in predicting transonic shock-wave boundary layer interaction. In addition, various test cases which have been performed are discussed. The algorithm used to solve the equations is based upon the consistently split linearized block implicit method of Briley and McDonald (15, 16). The philosophy and use of a solution adaptive mesh is also described. The test cases studied in this report are: normal shock wave boundary layer interaction in a constant area circular pipe, steady transonic flow over an axisymmetric bump, unsteady flow over an axisymmetric bump, supersonic flow over an axisymmetric compression corner and oblique shock wave impingement on a flat plate boundary layer. Author (GRA)

N84-28753# Coast Guard Research and Development Center, Groton, Conn.

AIRSHIP PROOF-OF-CONCEPT EVALUATION Interim Report, period ending Aug. 1983

H. G. KETCHEN May 1984 62 p
(AD-A141759; CGR/DC-4/84; USCG-D-12-84) Avail: NTIS HC A04/MF A01 CSCL 01B

Field tests were conducted off Oregon Inlet, NC, to evaluate the small target detection capability of lookouts on board an airship of modern design and materials and the potential advantages in the use of this type of platform for marine science activities (MSSA) in support of a variety of Coast Guard missions. Visual searches were conducted for small orange-canopied life rafts (4- to 6-man) and simulated persons in the water. The MSA experiments investigated the airship's capability to interface with the ocean including air and water sampling from the ocean surface and near surface, remote sensing, and air deployment/recovery of current measuring devices and other instruments. Target and airship positions were monitored with a computer-controlled microwave tracking system providing trackline and detection/miss range reconstruction accuracy to better than 0.1 nautical miles. The very limited size of the detection data base did not permit a complete evaluation of the platform's performance under a wide variety of environmental conditions and in searches for a number of different target types, but it did allow for a first order estimate of small target search performance under good weather conditions. The data indicates that the airship appears to be at least as good as and possibly an even better visual search platform than fixed or rotary wing aircraft used under similar conditions. For MSA use, the airship displayed excellent versatility and adaptability, lending itself well for this type of work. GRA

N84-28754# Tennessee Univ. Space Inst., Tullahoma.

TRANSONIC INTERFERENCE FLOW-FIELD ANALYSIS FOR WING-BODY-PYLON-STORE Final Report, Sep. 1981 - Sep. 1982

P. SUNDARAM and S. N. CHAUDHURI May 1983 150 p
(Contract F08635-81-C-0235; AF PROJ. 2307)
(AD-A141811; AD-E800931; AFATL-TR-83-42) Avail: NTIS HC A07/MF A01 CSCL 20D

An approximate method to compute the flow-field velocities around wing-body-pylon-store configurations is presented. The method adds transonic non-linear velocities to the linear velocities, computed using Hess's panel method. The non-linear effects are computed by an Integral Equation method derived for three-dimensional transonic small disturbance equations. A viscous/inviscid interaction procedure incorporates Cebeci's two-dimensional small cross flow boundary layer computations.

Viscous effects over lifting and non-lifting bodies are included. The viscous effects can be simulated by either the displacement or blowing method. Also outlined is the inclusion of weak separation and wake effects in the interaction procedure. An internal flow correction is applied to predict the flow in the region between the store and the wing. A finite difference scheme to solve the full potential equations over an axisymmetric body is used to compute the transonic non-linear effects for the store-on-body pressure computation. GRA

N84-28755# Aeronautical Research Labs., Melbourne (Australia).

AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC EFFECTS OF FORWARD FACING WEDGES ON THE UPPER SURFACE AND LEADING EDGE OF AN AEROFOIL, WITH EMPHASIS AT HIGH ANGLES OF ATTACK

A. P. BROWN Aug. 1983 54 p
(AD-A142053; ARL-AERO-TM-356) Avail: NTIS HC A04/MF A01 CSCL 01A

Wind tunnel tests were carried out to determine the effect on the longitudinal aerodynamic characteristics of a two-dimensional aerofoil fitted with discrete forward-facing wedges (base to aerofoil chord ratio 0.24 and 0.39) at the leading edge and on the upper surface of the aerofoil. The forward-facing wedges were conceived as a means of delaying stall and enhancing lift at high incidence. Thus these may be useful in low speed flight (approach and landing) where they would be extended from the clean wing surface along with the trailing edge flaps. Tests were conducted at Mach numbers 0.2/0.3, over an incidence range of -10 to +20 degrees. Corresponding chord Reynolds numbers were 0.57 and 0.84 million (compared to an inflight value of 2.5 million for a wing of chord 1.25 meters and airspeed of 60 knots). The results at $M=0.2$ are more extensive than those at $M=0.3$. GRA

N84-28756# Research Inst. of National Defence, Stockholm (Sweden). Dept. 2.

PARACHUTE DESCENT FROM ALTITUDE 5000 TO 7000 METERS

C. BJURQVIST, C. SPAANGBERG, and O. TILLHAGEN Feb. 1983 13 p In SWEDISH; ENGLISH summary
(FOA-C-59008-H1; ISSN-0347-7665) Avail: NTIS HC A02/MF A01

In order to simulate ejection from Swedish Air Force aircraft type 35 or 37, parachute descents were made from altitudes up to 7000 m with fall in a drag chute down to 3000 meters where the main parachute was manually deployed. Three parachutists used Air Force standard flying suits and equipment. The experiences from the descents are reported and proposals are made about high altitude clothing and equipment, e.g., oxygen masks. Author (ESA)

N84-28757# European Space Agency, Paris (France).

MEASUREMENT OF UNSTEADY AERODYNAMIC PRESSURES

P. BUBLITZ May 1984 25 p refs Transl. into English of "Messung von Instationaeren Aerodynamik Druecken" rept. DFVLR-Mitt-83-08 DFVLR, Goettingen, West Germany, 1983 (ESA-TT-834; DFVLR-MITT-83-08) Avail: NTIS HC A02/MF A01; original German version available from DFVLR, Cologne DM 11,50

User requirements on pressure transducers for measuring unsteady pressures are outlined. Application of the unsteady aerodynamic pressure measuring technique to the flutter and the dynamic response problem is described. It is shown that the requirements set for steady state aerodynamic pressure distribution measurements (such as a high resolution and intensivity to temperature drifts, overload and accelerations) are particularly necessary in the case of unsteady pressure measurements.

Author (ESA)

02 AERODYNAMICS

N84-28758# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Instationaere Aerodynamik.

COMPARATIVE MEASUREMENTS OF THE UNSTEADY PRESSURES ON THREE OSCILLATING WING-TIP MODELS

W. WAGNER Jan. 1984 68 p refs
(DFVLR-FB-84-07) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 23,50

Low speed wind tunnel investigations on steady and unsteady pressure distributions of ogee, trapezoidal and tapered wing tips are discussed. A rectangular blade serves as a reference. The decisive parameter variables are angle of attack, frequency and amplitude of the forced harmonic oscillations about the $l/4$ axis, and Reynolds number. The boundary regions where flow separation begins and dynamic stall occurs are also investigated. Tip vortex formation and shape in the pressure distribution on the blade surfaces are studied. Pressure distribution curves of the vortex parameters calculated by ultrasonic measurements of the wake are considered. Author (ESA)

N84-28759# Imperial Coll. of Science and Technology, London (England). Computational Fluid Dynamics Unit.

SIMULATION OF VEHICLE AERODYNAMICS BY MEANS OF A GENERAL-PURPOSE COMPUTER PROGRAM

D. B. SPALDING May 1984 18 p refs
(CFD/84/4) Avail: NTIS HC A02/MF A01

Application of the PHOENICS computer code to automobile engine flow dynamics simulation and to vehicle aerodynamics is summarized. The three dimensional Navier-Stokes model is realistic and fairly economical. Although cheaper, and realistic for the front half of the vehicle, the potential method requires information about flow in the wake, which only Navier-Stokes solutions can provide. Combination methods (potential + boundary layer + Navier-Stokes + turbulence model) are feasible. Comparisons with experiments for simple shapes are encouraging. One code suffices for simulating engines, vehicle aerodynamics, flow through valves, inlet and exhaust manifolds, heat-exchange equipment, air conditioning, lubrication, and body-vehicle impact. Author (ESA)

N84-29851*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.

IMPLEMENTATION OF UNIFORM PERTURBATION METHOD FOR POTENTIAL FLOW PAST AXISYMMETRIC AND TWO-DIMENSIONAL BODIES Progress Report, period ending 31 May 1984

T. C. WONG and S. N. TIWARI Aug. 1984 152 p refs
(Contract NCC1-65)
(NASA-CR-173829; NAS 1.26:173829) Avail: NTIS HC A08/MF A01 CSCL 01A

The aerodynamic characteristics of potential flow past an axisymmetric slender body and a thin airfoil are calculated using a uniform perturbation analysis method. The method is based on the superposition of potentials of point singularities distributed inside the body. The strength distribution satisfies a linear integral equation by enforcing the flow tangency condition on the surface of the body. The complete uniform asymptotic expansion of its solution is obtained with respect to the slenderness ratio by modifying and adapting an existing technique. Results calculated by the perturbation analysis method are compared with the existing surface singularity panel method and some available analytical solutions for a number of cases under identical conditions. From these comparisons, it is found that the perturbation analysis method can provide quite accurate results for bodies with small slenderness ratio. The present method is much simpler and requires less memory and computation time than existing surface singularity panel methods of comparable accuracy. Author

N84-29852*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ACCELERATION TO A STEADY STATE FOR THE EULER EQUATIONS Final Report

E. TURKEL Jul. 1984 47 p refs
(Contract NAS1-16394; NAS1-17130)
(NASA-CR-172398; NAS 1.26:172398; ICASE-84-32) Avail: NTIS HC A03/MF A01 CSCL 01A

A multi-stage Runge-Kutta method is analyzed for solving the Euler equations exterior to an airfoil. Highly subsonic, transonic and supersonic flows are evaluated. Various techniques for accelerating the convergence to a steady state are introduced and analyzed. Author

N84-29853*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

INTERFERENCE DRAG IN A SIMULATED WING-FUSELAGE JUNCTURE Final Report

L. R. KUBENDRAN, H. MCMAHON, and J. HUBBARTT Washington NASA Jul. 1984 60 p refs
(Contract NAG1-306)
(NASA-CR-3811; NAS 1.26:3811) Avail: NTIS HC A04/MF A01 CSCL 01A

The interference drag in a wing fuselage juncture as simulated by a flat plate and a body of constant thickness having a 1.5:1 elliptical leading edge is evaluated experimentally. The experimental measurements consist of mean velocity data taken with a hot wire at a streamwise location corresponding to 16 body widths downstream of the body leading edge. From these data, the interference drag is determined by calculating the total momentum deficit (momentum area) in the juncture and also in the two dimensional turbulent boundary layers on the flat plate and body at locations sufficiently far from the juncture flow effect. The interference drag caused by the juncture drag as measured at this particular streamwise station is -3% of the total drag due to the flat plate and body boundary layers in isolation. If the body is considered to be a wing having a chord and span equal to 16 body widths, the interference drag due to the juncture is only -1% of the frictional drag of one surface of such a wing. Author

N84-29854*# National Aeronautics and Space Administration, Washington, D. C.

ANALYSIS OF AIRFOIL TRANSITIONAL SEPARATION BUBBLES Final Report

R. L. DAVIS and J. E. CARTER Washington NASA Jul. 1984 72 p refs
(Contract NAS1-16585)
(NASA-CR-3791; NAS 1.26:3791) Avail: NTIS HC A04/MF A01 CSCL 01A

A previously developed local inviscid-viscous interaction technique for the analysis of airfoil transitional separation bubbles, ALESEP (Airfoil Leading Edge Separation) has been modified to utilize a more accurate windward finite difference procedure in the reversed flow region, and a natural transition/turbulence model has been incorporated for the prediction of transition within the separation bubble. Numerous calculations and experimental comparisons are presented to demonstrate the effects of the windward differencing scheme and the natural transition/turbulence model. Grid sensitivity and convergence capabilities of this inviscid-viscous interaction technique are briefly addressed. A major contribution of this report is that with the use of windward differencing, a second, counter-rotating eddy has been found to exist in the wall layer of the primary separation bubble. Author

N84-29855# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.

THEORETICAL AND MEASURED AIRFLOW ABOUT THE TWIN OTTER WING Aeronautical Note

A. M. DRUMMOND and J. I. MACPHERSON Mar. 1984 42 p
(AD-A141974; NAE-AN-19; NRC-33184) Avail: NTIS HC A03/MF A01 CSCL 20D

The NAE Twin Otter atmospheric research aircraft carries instruments mounted under the wings to count and image cloud

and precipitation particles for cloud physics studies. As part of an investigation on the influence of the aircraft presence on these measurements, airflow velocities about the wing have been calculated. These theoretical results have been compared with in-flight measurements taken by pressure probes mounted in a cannister suspended from a long and a short pylon below the wing at two spanwise locations. The Twin Otter wing has been represented by a Joukowski aerofoil of the same maximum thickness but with a cusped trailing edge. The wing camber has been neglected but aspect ratio and planform effects have been included. The effect of the cannister was included in the comparison of theory with experiment. Use of theory aft of the quarter chord will require experimental verification. Both experimental and theoretical results for the local flow velocity ratio are linear functions of aircraft lift coefficient (CL) in the range of CL between 0.35 to 1.06. The worst discrepancy between theory and experiment in the CL range of 0.4 to 0.6 is -2.8% to +1.1%. The results for the inboard/long pylon and outboard/short pylon have considerably less deviation. The theory has been experimentally verified to the above accuracy and can be used to describe the spatial variation of the flow velocity ahead of the wing. Applications of the theory to the study of aircraft flow effects on cloud physics measurements can proceed with a quantifiable level of confidence.

Author (GRA)

N84-29856# Dayton Univ., Ohio. Research Inst.
THRUST AUGMENTATION STUDY OF HIGH PERFORMANCE EJECTORS Final Report, 15 Mar. 1982 - 15 Mar. 1983
 J. E. MINARDI and H. P. VONOHAIN Wright-Patterson AFB, Ohio AFWAL Nov. 1983 88 p
 (Contract F33615-82-K-3016)
 (AD-A142650; UDR-TR-83-37; AFWAL-TR-83-3087) Avail: NTIS HC A05/MF A01 CSCL 20D

A technique is developed for determining a representative value of the maximum efficiency that can be achieved with high performance ejectors when operating on the supersonic solution branch of an ejector. These efficiencies are used to calculate thrust augmentation for an ejector over a wide range of parameters including operation with a hypothetical engine. Reasonable values of thrust augmentation can be achieved at low subsonic flight Mach numbers. However, at flight Mach numbers near one, little or no thrust augmentation was found. At supersonic flight Mach numbers, thrust augmentation was achieved. Basic studies indicated that the effects of temperature was opposite at subsonic and supersonic flight Mach numbers. Thrust augmentation decreased with increasing temperature at subsonic Mach number and increased with increasing temperature at supersonic Mach numbers.

GRA

N84-30115# Chiba Univ. (Japan). Dept. of Mechanical Engineering.
RANDOM-CHOICE SOLUTIONS FOR TWO-DIMENSIONAL AND AXISYMMETRIC SUPERSONIC FLOWS
 H. HONMA, M. WADA, and K. INOMATA In Inst. of Space and Astronautical Science Proc. of the Symp. on Mech. for Space Flight p 3-14 Mar. 1984 refs
 Avail: NTIS HC A06/MF A01

A two-dimensional random-choice code was developed to compute the steady two-dimensional and axisymmetric supersonic inviscid flows over arbitrary body shapes. A two-dimensional Riemann problem is solved for each spatial mesh at each spatial step marching downstream in one way. Its solution is constructed by a combination of an oblique shock wave and a Prandtl-Meyer expansion wave. An extended Godunov's iterative technique is developed to get the solution. The oblique coordinates and an operator-splitting technique are employed which permits the code to march along the body surface and to apply the axisymmetric flow. The computed shock positions and pressure distributions for a confluence of two-dimensional supersonic jets (shock-tube analogy) and for flows over a diamond airfoil and a cone are found to be in good agreements with analytical ones. A conical N-wave solution is obtained in a supersonic flow over a double

cone by combining the oblique coordinates with the operator-splitting technique.

Author

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AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A84-41074

SITUATIONAL EMERGENCY TRAINING - EXPERIENCES AND IMPLICATIONS

L. F. LUCACCINI and A. FREEDY (Perceptronics, Inc., Encino, CA) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 225-240. refs
 (Contract F49620-78-C-0067)

Initial guidelines for improving the training of military aircrews for emergency situations are presented. The guidelines incorporate decision task-related aspects of emergency events and the environmental factors which affect reactions to emergency situations. Predictability is used as the organizing element in an analysis of cues which accompany aircraft emergencies, and three different classes of emergency situations are identified. The hypothesis generation phase of emergency decision-making was found to require special attention because of the continuing trend toward greater cockpit automation in high performance military aircraft.

I.H.

A84-41079

THE AVIATION SAFETY ANALYSIS SYSTEM (ASAS) - AN OVERVIEW

W. R. FROMME (FAA, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 279-283.

The Federal Aviation Administration's Aviation Safety Analysis System (ASAS), which is a comprehensive new system to upgrade significantly the agency's ability to collect, process, and disseminate safety-related information, is described. Five selected prominent data systems slated for inclusion in ASAS are listed and briefly described.

C.D.

A84-41233

THE SEMBB MK 10 EJECTION SEAT [LE SIEGE EJECTABLE SEMBB MK 10]

C. CHARGE and H. VIEILLEFOND (Centre d'Essais en Vol, Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge, Essonne, France) (Journée de Medecine Aeronautique de la Force Aerienne Tactique, Metz, France, Nov. 4, 1983) Medecine Aeronautique et Spatiale, vol. 23, 2nd Quarter, 1984, p. 167-173. In French.

The Mk 10 ejection seat has been used for 27 yr in a series of French combat aircraft. Suitable for ejections at speeds from 0-625 kt, the Mk 10 can be operated at any altitude and can reach full aeroconical chute deployment 1.5 sec after the initiation of the ejection sequence. Ejection is assisted by a sub-seat rocket. The seat is designed to withstand a 40 g crash. Ejections are angled to minimize the spinal forces. The 1.5 sec deployment occurs only if ejection is below 16,500 ft altitude and acceleration is under 2 g. The seat carries a radio beacon to aid rescue crews in finding the pilot.

M.S.K.

A84-41242

FLYING THE LEAN MACHINE BOEING 757

P. A. WOODBURN (Boeing Co., Seattle, WA) Aerospace (UK) (ISSN 0305-0831), vol. 11, July-Aug. 1984, p. 27-29.

The Boeing 757, an aircraft intended for two-pilot operation, has built-in test equipment and simplified controls due to monitoring with improved redundancy. In comparing the 757 and 737 cockpits, main system differences include the Electronic Flight Instrument System, the Flight Management Computer System, and the Engine Indicating and Crew Alerting System. Another feature of the 757 is a Triple IRS which provides basic attitude, position, and eliminates the magnetic compass. An Electronic Engine Control (EEC) allows rapid execution of specific power settings. The HSI panel controls a large number of facilities and many displays on a cathode-ray tube, including the aircraft's position and heading, distance and ETA to the next active waypoint, plus windspeed and direction. Manual selection of radio aids is confined to departure and arrival, with ADF and ILS if required. The FMCS and HSI combination provides storage of departure and arrival procedures, go-around procedures, and optimum aircraft performance management for weight, altitude, temperature, and cost index. EICAS provides primary and secondary engine data, a master caution, and a warning display. Aerodynamics, design, advanced weight-saving materials, and fuel-efficient large fan engines all combine to give flexibility to an aircraft with a range of up to 3,500 miles. J.P.

A84-41698

HELICOPTER CRASH SURVIVABILITY AND EMERGENCY ESCAPE

J. J. TYBURSKI (U.S. Naval Air Development Center, Life Support Engineering Div., Warminster, PA) SAFE Journal, vol. 14, no. 2, 1984, p. 22-32. refs

The Navy Helicopter Aircrew Survivability Enhancement Program (HASEP) has been implemented in order to increase the probability of survival for helicopter aircrews and passengers under emergency conditions such as crash landings, ditchings, aircraft inversion, high sea states, and reduced aircraft lighting. The objectives of the program include: protection against the hazards of impact forces through the use of attenuation systems such as body and head restraint systems; introduction of a helicopter emergency egress lighting (HEEL) system which provides illumination of emergency exits at the sensing of a decrease in rotor blade speed; an introduction of a helicopter emergency flotation system (HEFS) which increases aircraft buoyancy and stability after rotor shutdown. Implementation of the program is intended to provide helicopter occupants the time to accomplish a successful egress from an aircraft under conditions complicated by disorientation, confusion, and panic. J.P.

A84-42353* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

GROUND-SIMULATION INVESTIGATION OF VTOL INSTRUMENT FLIGHT RULES AIRWORTHINESS CRITERIA

J. V. LEBACQZ (NASA, Ames Research Center, Moffett Field, CA) and B. C. SCOTT (FAA, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 265-285. refs (AIAA PAPER 84-2105)

A two-part ground-simulation investigation of VTOL terminal-area operations, conducted as part of a joint NASA/FAA program to develop airworthiness criteria for this class of vehicle, is described. The baseline vehicle selected for the simulations was a generalized version of the XV-15 tilt-rotor mathematical model, which was modified to permit generic variations in forces or moments or both with power or configuration changes. Additionally, changes to wing area and rotor-blade chord were considered as a means of modifying the allowable thrust-angle versus speed relationships (the conversion corridor). The Vertical Motion Simulator at Ames Research Center was used in the experiment. Four engineering test pilots conducted over 200 piloted evaluations examining the influence of the experimental variables on their ability to perform terminal-area operations. Author

A84-42567

CRASH PERFORMANCE OF AL AND FIBER-REINFORCED-COMPOSITE STRUCTURAL ELEMENTS [CRASHVERHALTEN VON STRUKTURELEMENTEN AUS ALUMINIUM UND FASERVERBUNDWERKSTOFFEN]

C. KINDERVATER and D. C. BANNERMAN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Bauweisen und Konstruktionsforschung, Stuttgart, West Germany) DFVLR-Nachrichten (ISSN 0011-4901), vol. 42, June 1984, p. 4-7. In German.

Stringer-supported, sandwiched, and sinusoidal-spar aircraft and helicopter subfloor energy-absorbing structural elements of Al, CFRP, and hybrid GF/CFRP are subjected to mechanical and crash tests. Test elements 150 mm thick and 100 x 40, 100 x 100, or 150 x 70 mm in cross section, respectively, are static tested at loading velocity 2 mm/min until a first peak is reached, and further deformation is induced at 20 mm/min; crash tests involve dropping a weight equipped with an acceleration recorder from heights up to 16 m. Photographs of deformed structures and a graph of specific energy absorption versus loading uniformity are shown. The composite elements are found to give performance equal to or better than similar Al elements, with best results for hybrid composite sinusoidal-spar structures. T.K.

N84-28760# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORT: LAS VEGAS AIRLINES, FLIGHT 88, PIPER PA-31-350, GRAND CANYON, ARIZONA, AUGUST 17, 1983

15 May 1984 24 p

(PB84-910405; NTSB-AAR-84-05) Avail: NTIS HC A02/MF A01 CSCL 01C

A Piper PA-31-350, N88LV, departed North Las Vegas Airport as the second of five Las Vegas Airlines airplanes flying to Grand Canyon National Park Airport. When weather conditions precluded flying over the Shivwits Plateau under visual conditions as normally done, the pilot flew into the west end of the Grand Canyon at 5,000 feet. Deteriorating weather conditions were encountered. The pilot decided to abort the flight and climb out. Attempts to contact Las Vegas 88 by radio were fruitless. The wreckage was found on August 18, 1983, by company pilots on the west wall of a mesa inside the Canyon. The airplane was destroyed by impact and by postimpact fire. The pilot and all nine passengers were killed. The National Transportation Safety Board determines that the probable cause of this accident was the pilot's failure to maintain adequate visual flight references to positively identify his position while flying below the rim of the Grand Canyon which resulted in his selection of an inappropriate flightpath and consequent collision with the terrain during an attempt to climb the airplane in instrument meteorological conditions to a safe altitude above the rim of the canyon. A.R.H.

N84-28761# National Transportation Safety Board, Washington, D. C.

SAFETY STUDY: AIRPORT CERTIFICATION AND OPERATIONS

11 Apr. 1984 83 p

(PB84-917002; NTSB-SS-84-02) Avail: NTIS HC A05/MF A01 CSCL 01C

The nature and scope of regulations governing airport certification, the Federal Aviation Administration's (FAA) method of assuring compliance with the regulations, and the FAA's airport inspections are evaluated. Facility and equipment conditions and airport programs and procedures which exist to satisfy regulatory requirements, such as bird hazard reduction, snow removal, fuel storage and handling, public protection, ground vehicle operation, crash fire rescue training, condition assessment and reporting, and emergency plan exercises are discussed. Complex issues of obstructions, noise abatement procedures, and land use which have plagued airports, landowners, and local authorities for years are addressed as well as their relationship to the potential for loss and destruction as a result of accidents in residential or commercial areas which have surrounded and constrained some

airports. Analysis of air carrier accidents occurring in the United States from 1964 to 1981 in which airplanes had traversed areas adjacent to runways shows substantial decrease in rates of all encroachment accidents during the postverification period (1973 through 1981) is the consistently low rate of air carrier overshoot accidents since 1977 is noteworthy. A.R.H.

N84-28762# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A SLAM (SIMULATION LANGUAGE FOR ALTERNATIVE MODELING) AIRFIELD MODEL FOR AIRLIFT OPERATIONS M.S. Thesis

R. G. JOHNSON Mar. 1984 68 p
(AD-A141106; AFIT/GST/OS/84M-12) Avail: NTIS HC A04/MF A01 CSCL 15E

This study developed a SLAM airfield tailored for airlift operations. The model is formulated as a network and models loading, fueling, and maintenance of airlift aircraft. Only C-130, C-141, and C-5 aircraft can be considered. The primary model inputs are aircraft input rates, and the availability of ramp space, maintenance team, load team, and k-loader resources. The output includes average ground-time, resource usage, and pallets airlifted from the airfield. An experiment is made to identify a 'best' strategy for aircraft input rates through a fixed airfield. The results show that any one of five input strategies out of 64 examined are of equal effectiveness. Author (GRA)

N84-28763# Logistics Management Inst., Washington, D. C.
SYSTEM SAFETY IN AIRCRAFT ACQUISITION

F. R. FROLA and C. O. MILLER Jan. 1984 119 p
(Contract MDA903-81-C-0166)
(AD-A141492; LMI-ML214) Avail: NTIS HC A06/MF A01 CSCL 05A

This report identifies management initiatives for strengthening the effectiveness of system safety in aircraft acquisition programs. More aggressive implementation of existing system safety policy can help reduce the mishap rate and the need for costly modification programs to correct safety deficiencies. Recommendations to OSD and the Military Departments include: (1) the need for continuing top management support; (2) staffing and funding for system safety efforts commensurate with responsibilities set forth in policy statements; (3) emphasis on the man-machine interface and the associated need for better coordination of system safety and human factors engineering activities; (4) improved methods for detecting system software hazards; (5) better utilization of advanced technology, including flight data recorders, ground proximity warning systems, and collision avoidance systems; (6) writing better contracts with respect to system safety tasks; and (7) more effective recruiting, training, and retention of system safety personnel. Author (GRA)

N84-28764# Federal Aviation Agency, Atlantic City, N.J.
STUDY ON TRANSPORT AIRPLANE UNPLANNED WATER CONTACT Final Report, 1981 - 1982

D. JOHNSON Jan. 1984 38 p
(AD-A142092; DOT/FAA/CT-84/3) Avail: NTIS HC A03/MF A01 CSCL 01B

This study provides for an identification of accident scenario(s) and associated occupant risks and survival equipment needs, relating to the inadvertent or unplanned water contact of transport category airplanes. This identification was obtained, in part, from the results of contractual studies of transport accident data. The subject study concludes that while the unplanned water contact of a transport airplane occurs less frequent than corresponding ground contact, the impact loads are often higher, leading to greater fuselage damage. Also, the unplanned water contact occurs more frequent than a planned water landing (ditching) and usually involves adverse flooding conditions. These conditions, in turn, affect the ability of occupants to retrieve, deploy and/or don on-board floatation equipment. GRA

N84-29857*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A METHOD FOR THREE-DIMENSIONAL MODELING OF WIND-SHEAR ENVIRONMENTS FOR FLIGHT SIMULATOR APPLICATIONS

R. S. BRAY Jul. 1984 17 p refs
(NASA-TM-85969; A-9777; NAS 1.15:85969) Avail: NTIS HC A02/MF A01 CSCL 01C

A computational method for modeling severe wind shears of the type that have been documented during severe convective atmospheric conditions is offered for use in research and training flight simulation. The procedure was developed with the objectives of operational flexibility and minimum computer load. From one to five, simple down burst wind models can be configured and located to produce the wind field desired for specific simulated flight scenarios. A definition of related turbulence parameters is offered as an additional product of the computations. The use of the method to model several documented examples of severe wind shear is demonstrated. Author

N84-29858# General Accounting Office, Washington, D. C. Resources, Community, and Economic Development Div.

THE CHANGING AIRLINE INDUSTRY: A STATUS REPORT THROUGH 1982

6 Jul. 1983 34 p
(GAO/RCED-83-179; B-197119) Avail: NTIS HC A03/MF A01

Changes in airline traffic, fares, profits, productivity, and air service patterns are discussed for the first 5 years after deregulation. It is shown that in 1982 air fares fell below 1981 levels, while costs increased slightly. In addition, air traffic, weekly departures, available seats, and load factors all turned upward. The airline industry's return on investment, however, continued the decline started in 1979. There was no evidence that deregulation adversely affected air safety in 1979, 1980, or 1981. Air traffic safety statistics for 1982 indicate a lower overall accident rate for certificated airlines, but two major fatal accidents that year raised the 1982 fatality rate significantly above that of 1981. A.R.H.

N84-29859# National Bureau of Standards, Washington, D.C. National Engineering Lab.

DECISION ANALYSIS MODEL FOR PASSENGER-AIRCRAFT FIRE SAFETY WITH APPLICATION TO FIRE-BLOCKING OF SEATS Interim Report, Nov. 1982 - Dec. 1983

J. R. HALL, JR. and S. W. STIEFEL Atlantic City, N.J. FAA Apr. 1984 104 p
(Contract DTFA30-83-A-0034)
(AD-A142477; NBSIR-84-2817; DOT/FAA/CT-84/8) Avail: NTIS HC A06/MF A01 CSCL 01B

This report develops a generic model for analysis of the costs and benefits of fire-risk reducing strategies related to passenger airlines. The model calculates incremental costs for installing and operating these options. It also calculates estimated lives saved and property damage avoided, and it provides rules for combining costs and benefits into a single measure of attractiveness for an alternative. This model is then applied to the strategy of fire-blocking seats on passenger airlines, either on U.S. airlines or on all world airlines. Author (GRA)

N84-29941# Universal Propulsion Co., Phoenix, Ariz.

HISTORY OF AIRCRAFT ESCAPE SYSTEM PROPULSION

R. F. SADLER and E. B. SKINNER (Talley Industries of Arizona, Inc.) In APL The 1984 JANNAF Propulsion Meeting, Vol. 2 p 11-20 Feb. 1984
Avail: NTIS HC A15/MF A01 CSCL 01C

A brief history of the use of propulsive elements in aircrew escape systems is presented. Both closed propulsion elements (catapults), as well as rocket motors are considered since early ejector seats depended solely on catapults for their motive source. Applications of rocket motors other than for providing the main impetus to the escape system are also considered in more recent systems. Information was obtained from all types of literature both published and unpublished as well as from discussions with

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individuals who were involved in the escape system arena from its infancy. R.J.F.

N84-29942# Douglas Aircraft Co., Inc., Long Beach, Calif. Special Products Engineering.

PROPULSION IN A LIFE-SAVING ROLE FOR ACES 2

R. G. MCINTYRE /In APL The 1984 JANNAF Propulsion Meeting, Vol. 2 p 21-32 Feb. 1984
(Contract F33657-72-C-0379)

Avail: NTIS HC A15/MF A01 CSCL 01C

The propulsion system for the ACES 2 high technology ejection seat consists of three solid propellant units: a main rocket catapult assembly to launch the seat from the cockpit and boost it into its desired trajectory (1,120 lb-sec impulse); a gyro-controlled vernier rocket to stabilize the seat in pitch (235 lb-sec); and a small roll rocket (22 lb-sec) to provide trajectory separation for multicrew applications. Design requirements of the propulsion system are examined along with specific physical and performance details of each unit. The operation of the complete ACES 2 system is described to show its demands upon propulsion. Finally, system performance information is presented to show that propulsion and system requirements were achieved, thus leading to the high life saving record of the ACES 2 ejection seat. R.J.F.

N84-29943# Stencel Aero Engineering Corp., Arden, N.C.

THE STENCEL S4S EJECTION SEAT: A STUDY IN NEW PYROTECHNIC DEVELOPMENTS

M. A. A. HOBBS /In APL The 1984 JANNAF Propulsion Meeting, Vol. 2 p 33-42 Feb. 1984

Avail: NTIS HC A15/MF A01 CSCL 01C

The development of a new generation ejection seat, the Stencel S4S, is discussed with particular reference to the propulsion and initiation systems and sub-systems. The reasons for development were to improve performance, to increase reliability, and to reduce both initial and life cycle costs. Design objectives were established which included yaw stability by means of dual fins mounted alongside the seat, which are extended mechanically and aerodynamically as the seat leaves the airplane during the ejection phase. The propulsion package consists of a twin tube catapult and twin rocket motors. Positive stability achieves increased tolerance to the 'eyeballs out' deceleration because a man can stand a greater level of deceleration when he is kept pointing directly into the relative airflow. R.J.F.

N84-29944# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. CREST Advanced Development Program Office.

CREST: CREW ESCAPE TECHNOLOGIES FOR THE 1990'S

A. M. HIGGINS and E. O. ROBERTS /In APL The 1984 JANNAF Propulsion Meeting, Vol. 2 p 43-48 Feb. 1984 refs

Avail: NTIS HC A15/MF A01 CSCL 01C

An overview of the CREST Advanced Development Program is given. The CREST program's purpose is to develop and demonstrate an ejection seat that is a significant departure from traditional practice. This new ejection seat employed novel design approaches and advanced technologies to dramatically enhance the capabilities of the open ejection seat. Each of the new technologies incorporated into the CREST seat are discussed with emphasis placed on the need for continuous, conditional flight control. Particular emphasis is placed on the requirements for the seat's digital flight controller and its interaction with actuators such as selectable thrust, attitude control rockets. R.J.F.

N84-29945# Atlantic Research Corp., Gainesville, Va.

ENERGY MANAGEMENT FOR CREW ESCAPE SYSTEMS

M. G. HUBBELL, C. W. ANDERSON, and W. H. SARGENT /In APL The 1984 JANNAF Propulsion Meeting, Vol. 2 p 49-58 Feb. 1984 refs
(Contract F33615-83-C-3401)

Avail: NTIS HC A15/MF A01 CSCL 01C

The operational envelope of modern and advanced combat aircraft has extended beyond the capabilities of current crew escape systems. To reverse the trends toward increasing numbers

of fatalities and serious injuries during the ejection event, an energy management system capable of adapting the performance of the appropriate subsystem to the environment of the escape situation is investigated. The system will incorporate a real time microprocessor controller to receive, process, and transmit information, sensors to maintain aircraft, seat, and environmental conditions; and an adaptive propulsion system to provide forces and moments during ejection. R.J.F.

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A84-40011

SIMULATION OF AIRBORNE PULSE DOPPLER RADARS, TAKING INTO CONSIDERATION GROUND CLUTTER [SIMULATION VON PULSDOPPLER-BORDRADAREN UNTER BERUECKSICHTIGUNG DES BODENCLUTTER]

M. HOFFMANN and R. SCHULZ (Elektronik-System-Gesellschaft mbH, Munich, West Germany) (Deutsche Gesellschaft fuer Ortung und Navigation, Radarsymposium, 5th, Munich, West Germany, Nov. 8-10, 1983) Ortung und Navigation (ISSN 0474-7550), no. 1, 1984, p. 27-42. In German. refs

The detection of a flying target with the aid of the radar equipment of an aircraft represents a difficult technical problem, particularly if the target is found below the radar. Radar devices which possess such a 'look down' capability must be able to recognize the target against a very complex background. In case of the simulation of such radar devices, an investigation has to be conducted of aspects of signal processing and the imaging of the ground clutter. The present investigation is concerned with a simulation procedure which makes use of a recursive algorithm. An analysis of the involved geometric relations with respect to range and Doppler curves is conducted, and the calculation of the areas of distance/Doppler cells is discussed. Such a calculation is required for the determination of ground clutter distribution as a function of distance and Doppler shift. Attention is given to the antenna diagram, the clutter distribution, and details of signal processing. G.R.

A84-40012

ENVIRONMENT AND FACTORS INFLUENCING OPTIMUM MULTI-RADAR PROCESSING IN AIR TRAFFIC CONTROL

H. VON VILLIEZ (Eurocontrol, Maastricht, Netherlands) (Deutsche Gesellschaft fuer Kybernetik, Kybernetik-Kongress ueber Orientierung und Ortung in Technik und Biologie, 8th, Tuebingen, West Germany, Mar. 23-25, 1983) Ortung und Navigation (ISSN 0474-7550), no. 1, 1984, p. 44-54. refs

Semiautomatic air traffic control systems are now being employed with the objective to enhance system capacity. Certain shortcomings of conventional approaches regarding the combination of radar information from different sites can be overcome by utilizing a genuine multiradar data processing concept. The operational advantages of multiradar processing are examined. Attention is given to selected functions for system optimization, monitoring and automatic alignment of all radars, an improved probability of detection, the measuring and monitoring of radar coverage, conflict alert in the horizontal and vertical plane, and an optimum display system for processed radar data. G.R.

A84-40048

SELECTIVE-INTERROGATION SSR - A FUTURE TECHNIQUE FOR AUTOMATING ATC [SELEKTIVRUF-SSR - EIN KUNFTIGES AUTOMATISIERUNGSMITTEL DER FLUGSICHERUNG]

W. RASCHKE (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 20, no. 2, 1984, p. 59-70. In German. refs

The principles, design, and operation of selective-interrogation SSR (SISSR) systems for the further improvement and automation of ATC facilities are discussed in a review of recent international developments. The ATC systems of the 1960s and 1970s, the history of SISSR development, and the main disadvantages of conventional SSR systems are characterized; the requirements for ground-based and onboard components of a future SISSR are listed; and the operational parameters of proposed systems are summarized in graphs, diagrams, and tables, including working frequency, coverage, precision, interrogation modes, signal formats, data-block structure, and compatibility with conventional SSR and with proposed navigation, landing, and communication systems. The need for effective ground-air-ground digital communication channels, a ground-supported collision-prevention system, and international standardization is stressed. T.K.

A84-40251

FLUSH-MOUNTED ANTENNAS YIELD HIGH PERFORMANCE AND CLEAN DESIGN

C. VAN OVEREEM (Dayton-Granger, Inc., Costa Mesa, CA) Defense Systems Review and Military Communications, vol. 2, June 1984, p. 43-45.

The flush-mounted antennas under consideration for composite primary structure aircraft and helicopter airframes in the 1990s, for communication with satellites as well as traffic control stations, offer unique possibilities and performance improvements for onboard communications and navigation avionics systems. This family of antenna designs allows designers to preclude physical interface problems with moving airframe elements, reduce static charge buildups, reduce antenna structural loading requirements, and minimize an antenna's aerodynamic drag. O.C.

A84-40378

CONCEPT FOR A NEW RADAR DATA COLLECTION SYSTEM OF THE FEDERAL INSTITUTE FOR AIR TRAFFIC CONTROL [KONZEPT DES NEUEN RADARDATENGWINNUNGSSYSTEMS /SIDAPS/ DER BUNDESANSTALT FUER FLUGSICHERUNG /BFS/]

B. CLOOS (Bundesanstalt fuer Flugsicherung, Frankfurt am Main, West Germany) IN: Radar technology 1983; Symposium, 5th, Munich, West Germany, November 8-10, 1983, Reports. Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 4.1-4.13. In German.

The system concept of a new radar data collection system called the Radar Signal and Data Processing System (SIDAPS) is presented. The system's objective is continuous availability of exact and well-defined radar data in real time. A simplified one-channel principal switching diagram of the system is shown and the corresponding functions are described. Important aspects of the SIDAPS radar head modifications are given along with the main functions of the sensory data processing and the operational monitoring and control systems. Finally, the system's main specifications are presented. C.D.

A84-40379

DESIGN AND TESTING OF AN MTD SUBSYSTEM FOR AIR TRAFFIC CONTROL RADARS [AUFBAU UND ERPROBUNG EINES MTD-SUBSYSTEMS FUER FLUGSICHERUNGSRADARE]

A. LUDLOFF (Telefunken AG, Ulm, West Germany) IN: Radar technology 1983; Symposium, 5th, Munich, West Germany, November 8-10, 1983, Reports. Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 6.1-6.9. In German. Research supported by the Bundesministerium fuer Verkehr. refs

The architecture of a modified primary radar with MTD signal processing is addressed. Air traffic control radar objectives are first summarized and MTI and MTD radars are briefly compared. The design and function of an MTD test system are described. Tests show significantly improved target detection in clutter. Radar measurement errors approach the theoretically attainable values. Angels can be Doppler-selectively suppressed. C.D.

A84-40381

DIGITAL SLAR OF THE DFVLR - SYSTEM CONCEPT AND RESULTS [DIGITALE SLAR DER DFVLR - SYSTEMKONZEPT UND ERGEBNISSE]

F. WITTE (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) IN: Radar technology 1983; Symposium, 5th, Munich, West Germany, November 8-10, 1983, Reports. Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 8.1-8.18. In German.

A simple aircraft-borne Side-looking Airborne Radar (SLAR) with a real aperture is described. This instrument is the simplest image-forming microwave sensor which can be used to measure the differential back-scattering behavior of the earth's surface from an aircraft and to present the resulting images cartographically. The design and function of the SLAR are described, as are the antenna, transmitter and receiver units, its principle of digital data recording, its data conversion and reproduction, and its technical data and system parameters. C.D.

A84-40384

CALCULATION OF THE DETECTION RANGE OF PULSE-DOPPLER AIRBORNE RADAR SYSTEMS [ZUR BERECHNUNG DER ENTDECKUNGS-REICHWEITE VON PULSDOPPLER-BORDRADARSYSTEMEN]

P. SCHMITT (Telefunken AG, Ulm, West Germany) IN: Radar technology 1983; Symposium, 5th, Munich, West Germany, November 8-10, 1983, Reports. Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 12.1-12.9. In German.

A simple radar model is presented which can be used to determine the detection range of a modern pulse-Doppler airborne radar system in horizontal flight from the most important system and signal processing parameters. The most important part of the model is an approximation procedure for evaluating the ground clutter received over the major and minor lobes of the antenna. Typical operational data from an airborne system are used to show how the detection range in operational modes with high, medium, and low pulse frequency depends on the flight situation from the point of view of the observer and the target, and on the radar arrangement. C.D.

A84-40390

SIMULATION SYSTEM FOR DEVELOPMENT TASKS IN RADAR DATA PROCESSING [EIN SIMULATIONSSYSTEM ZUR UNTERSTUETZUNG VON ENTWICKLUNGS-AUFGABEN IN DER RADARDATENVERARBEITUNG]

U. WACKER (Telefunken AG, Ulm, West Germany) IN: Radar technology 1983; Symposium, 5th, Munich, West Germany, November 8-10, 1983, Reports. Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 27.1-27.20. In German.

A simulation system is presented which allows a project-independent test environment to be created along with test data for use in the development of real systems. The system

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permits the creation of complete dynamic situations in the air and/or targeted critical model situations for individual algorithms. Alternatively, recorded real data from aerial situations can be utilized. The analysis of the behavior of individual algorithms and of the system as a whole is assisted by run protocols as well as statistical and graphical evaluation aids. Examples of applications of the simulation system are presented. C.D.

A84-40572#

THE GLOBAL ROLE OF NAVSTAR

F. X. KANE (Rockwell International Corp., Pittsburgh, PA) and J. F. SCHEERER Aerospace America (ISSN 0740-722X), vol. 22, July 1984, p. 42-46. refs

The performance levels, services and equipment of the Navstar GPS are described. The GPS consists of the satellites, ground control stations and user stations. A multiyear production contract has called for 28 spacecraft, sufficient to ensure a 98 percent probability that 18 will be operational at any given moment. Latitude and longitude service is to begin in 1987 and speed data will become available in 1989. Accuracy is projected at 0.1 m/sec, 120 nsec, 3-5 m relative position error and relative time within 3-5 nsec of UTC. Navigational signals will be transmitted at 1575.42 and 1227.6 MHz, along with superimposed satellite precision and clear/acquisition signals. Time-synchronized transmissions will account for ionosphere-induced errors. Communication with four satellites will be necessary for location queries. Degraded performance due to the mask angle of the earth horizon will occur only once or twice a month. The spacecraft will be travelling in 10,900 n. mi. orbits in six planes. M.S.K.

A84-40888

DETERMINATION OF ACCURACY REQUIREMENTS OF FUTURE NAVIGATION SYSTEMS FOR TERMINAL AREAS BY MEANS OF A MONTE CARLO SIMULATION (ERMITTLUNG VON GENAUIGKEITSANFORDERUNGEN AN ZUKUNFTIGE NAVIGATIONSSYSTEME IM FLUGHAFENNAHBEREICH MIT HILFE EINER MONTE-CARLO-SIMULATION)

M. FRICKE and A. HOERMANN (Berlin, Technische Universitaet, Berlin, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, May-June 1984, p. 173-181. In German. refs

TMASIM, a Monte Carlo-type simulation program for traffic flow in an airport TMA with a fixed-path-segment speed-control system, is described and demonstrated. The model incorporates horizontal, vertical, and speed profiles and errors due to arrival time at the TMA entry fix, navigation system, wind, speed control, and flight-management system. The results of seven simulations using data for Frankfurt airport are presented in tables and graphs. T.K.

A84-41075

TOWARD THE TWENTY-FIRST CENTURY - MODERNIZATION OF THE NATIONAL AIRSPACE SYSTEM

G. L. THOMPSON and T. J. PHILUMALEE (FAA, Systems Engineering Service, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 243-248.

The major elements of the National Airspace System (NAS) Plan, which delineates specific improvements for facilities and equipment which must be made in order to meet projected demands for air transportation through the year 2000, are described and their merits are briefly explained. These elements include: computer modernization, design of sector suites and system software, automated en route ATC, integrated flow management, NAS architecture, flight service station automation, and weather system modernization. They also include: an aviation weather radar network, an automated Center Weather Service Unit, an improved Radar Beacon System, an upgraded communications system, navigation, a Microwave Landing System, and facility consolidation. C.D.

A84-41077

THE LOSS OF PRESCRIBED SEPARATION BETWEEN AIRCRAFT - HOW DOES IT OCCUR?

D. J. SCHROEDER (FAA, Civil Aeromedical Institute, Oklahoma City, OK) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 257-269. refs

One measure of the effectiveness or safety of the Air Traffic Control system is the occurrence of an operational error. The purpose of this study was to determine contributing factors and conditions surrounding the occurrence of an operational error. A longitudinal analysis of controller workload at the time of the error revealed some time-related changes. While most errors occurred under moderate workloads, since 1965 the trend has been for a smaller percentage of errors to occur under heavy workload conditions, with an increase in the percentage involving light workloads. While the precise determination of causal factors is not possible with the current system, emphasis should be placed on the importance of attention, planning, judgment, coordination, and communications. Some suggestions are made concerning the gathering of additional information during the review process to assist in the overall analysis of an operational error. Author

A84-41078

FAA'S TREND ANALYSIS DATA SYSTEM

T. S. WESTALL (FAA, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 275-277.

The Flight Standards aviation safety program of the Federal Aviation Administration, which develops and enforces all regulations affecting aircraft and airmen, is described. Data bases being utilized or developed to enhance safety are addressed, and two software packages developed to interface with a program which controls the data bases are described. One of these provides terminal graphics, while the other interfaces a data base with an on-line version of the Statistical Package for Social Sciences. C.D.

A84-42380

SIMULATION STUDY OF AN AIRBORNE ANTENNA BEAMFORMING ALGORITHM USING ORTHOGONAL PERTURBATION SEQUENCES

C. LEE (Aerospace Corp., El Segundo, CA) IN: Annual Pittsburgh Conference, 13th, Pittsburgh, PA, April 22, 23, 1982, Proceedings. Part 1. Research Triangle Park, NC, Instrument Society of America, 1982, p. 19-33. refs

This paper presents an overview of a null-steering algorithm of an adaptive array for the purpose of studying antenna processor performance on an aircraft. The algorithm is based on a steepest-descent feedback technique with antenna element weights perturbed by some specific sequences for the Mean Square Error performance measure gradient extraction. Typical simulated antenna patterns are presented and the performance characteristics of the adaptive algorithm are described. As demonstrated in Cantoni (1980), the penalty for the orthogonal perturbation technique is an increase in the processing time by a factor which is equal to the number of perturbed weights. Author

N84-28765# Engineering and Economics Research, Inc., Vienna, Va.

NATIONAL AIRSPACE REVIEW BENEFITS AND COSTS Interim Report, Sep. 1982 - Apr. 1984

L. H. MAYO, JR., H. W. MINNICK, J. H. DARGUE, and P. V. TAWARI May 1984 57 p refs
(Contract DTFA01-82-Y-30562)

(FAA-AT-84-1; IR-1) Avail: NTIS HC A04/MF A01

Three of the twenty enhancement areas identified for implementation within the National Airspace Review (NAR) are evaluated as to their benefits and costs. These areas are Airport Radar Service Area (ARSA), ARTCC Resectorization, and the Random routes aspect of area navigation (RNAV) Integration. A

methodological approach to evaluation of benefits and costs, suitable for application to all enhancement areas, is developed. Each of the three areas is treated in detail and supported by quantitative data placed in appendices. M.A.C.

N84-28766# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.

COCKPIT DATA MANAGEMENT REQUIREMENTS (CURRENT TECHNOLOGY AIRCRAFT) Final Report

T. P. BERRY Oct. 1983 309 p refs

(Contract DTFA01-80-C-10030)

(FAA-PM-83-25; REPT-1378-03-8-3150) Avail: NTIS HC A14/MF A01

A technique is described for estimating the effect of the data management tasks imposed on flight crews by new systems. It presents the development of a data base of data management tasks in current technology aircraft and examines the effect of four proposed new systems on the data management tasks of a flight crew in these aircraft. Data items and times for various emergency situations are included such as the effect of hydraulic and flight control malfunction and the effect of engine failure due to fire. Times and data items for these conditions were developed in a United Airlines DC-10 flight simulator. Flight crew task-loading profiles showing the action levels caused by the malfunction are included in each annex. A.R.H.

N84-28767*# McDonnell Aircraft Co., St. Louis, Mo.

STUDY OF AERODYNAMIC TECHNOLOGY FOR SINGLE-CRUISE-ENGINE V/STOL FIGHTER/ATTACK AIRCRAFT Final Report, Jun. 1981 - Feb. 1982

J. R. HESS and R. L. BEAR Feb. 1982 179 p refs Sponsored in part by the Naval Ship Research and Development Center and Naval Air Systems Command (Contract NAS2-11001)

(NASA-CR-166269; NAS 1.26:166269; MDC-IR0285) Avail: NTIS HC A09/MF A01 CSCL 01D

A viable, single engine, supersonic V/STOL fighter/attack aircraft concept was defined. This vectored thrust, canard wing configuration utilizes an advanced technology separated flow engine with fan stream burning. The aerodynamic characteristics of this configuration were estimated and performance evaluated. Significant aerodynamic and aerodynamic propulsion interaction uncertainties requiring additional investigation were identified. A wind tunnel model concept and test program to resolve these uncertainties and validate the aerodynamic prediction methods were defined. Author

N84-28768# Mitre Corp., McLean, Va. Metrek Div.

AIRCRAFT TRAFFIC DENSITY IN THE LOS ANGELES BASIN

N. A. SPENCER Aug. 1983 50 p

(Contract DTFA01-82-C-10003)

(AD-A141435; MTR-83W00091; DOT/FAA/PM-83/21) Avail: NTIS HC A03/MF A01 CSCL 01B

An estimate of the number of aircraft flying in the Los Angeles basin was made using airborne and ground-based radar measurements. These estimates are combined with FAA projections of traffic growth to predict the future aircraft density as seen by an airborne Traffic Alert and Collision Avoidance System (TCAS). Results include the findings that: (1) peak density decreases approximately linearly with radius, (2) the number of aircraft increases linearly with the sum of tower operations, (3) for year 2000, within a radius of 5 nmi, the projected maximum density is 0.45 aircraft/nmi², the projected maximum number of aircraft is 35, and the projected maximum number of ATCRBS aircraft is 20, and (4) within a radius of 10 nmi, these figures are 0.24, 75, and 43, respectively. GRA

N84-28769# Transportation Systems Center, Cambridge, Mass. **DIFFERENTIAL NAVSTAR GPS (GLOBAL POSITIONING SYSTEM) DESIGN CONCEPT FOR HARBOR/HARBOR ENTRANCE MARINE NAVIGATION Final Report, Oct. 1982 - Oct. 1983**

J. VILCANS and R. M. KALAFUS May 1984 80 p

(AD-A141665; DOT-TSC-CG-83-5; USCG-D-08-84) Avail: NTIS HC A05/MF A01 CSCL 17G

This report presents a design concept for a high-precision system for harbor/harbor entrance navigation. The concept is based on differential operation of NAVSTAR GPS, whereby local corrections to the satellite signals are broadcast to mariners in a harbor area. The system is expected to provide continuous navigation service with a predictable (absolute) accuracy of 8-12 meters (2drms). The design is configured around a hypothetical system to cover New York Harbor. The report addresses the hardware configuration and costs of installing and maintaining the system. Also provided are guidelines for verifying the performance of the system. GRA

N84-28770# Naval Ocean Systems Center, San Diego, Calif.

HP-85/MINI-RANGER NAVIGATION SYSTEM Final Report

R. UHRICH and M. MCCORD Apr. 1984 34 p

(AD-A142131; NOSC/TD-690) Avail: NTIS HC A03/MF A01 CSCL 17I

The HP-85/Mini-Ranger Navigation System consists of a general purpose personal computer and an off-the-shelf radar ranging device combined into an automatic and portable system for navigation near the shore. This system provides a real-time plot of ship's position relative to fixed transponders. Time and position data can be printed on paper or saved on magnetic tape. The computer program can be modified for any specific geographic location, making the system a readily transportable tool. Author (GRA)

N84-28771# Department of the Navy, Washington, D. C.

ANALOG FIBER GYRO WITH EXTENDED LINEAR RANGE Patent Application

W. K. BURNS and R. P. MOELLER, inventors (to Navy) 24 Feb. 1984 33 p

(AD-D011009; US-PATENT-APPL-SN-583549) Avail: NTIS HC A03/MF A01 CSCL 17G

The present invention relates generally to analog gyroscopes, and more particularly to an analog fiber optic gyroscope system which provides an extended linear dynamic range for platform rotation rate measurements. GRA

N84-28772# Elektronik-System G.m.b.H., Munich (West Germany). Technische Systeme Entwurf.

SATELLITE AIDED NAVIGATION (INNAVSAT) Final Report, Jun. 1982

J. WEGSCHEIDER Bonn Bundesministerium fuer Forschung und Technologie Mar. 1984 133 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-W-84-003; ISSN-0170-1339) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 28

The establishment of an international satellite organization INNAVSAT for a worldwide navigation/SOS system is considered. Technical, operational, and financial user requirements are defined in comparison with existing systems. It is concluded that available global positioning systems meet the technical/operational requirements of all users. It is recommended to promote the development of low cost medium to lower accuracy receivers. Author (ESA)

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N84-28773# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

DEVELOPMENT, SET UP AND TESTING OF A MEASURING SYSTEM FOR COMPONENTS OF THE DERIVED AZIMUTH SYSTEM (DAS) Final Report, Dec. 1982

H. WINTER. Bonn Bundesministerium fuer Forschung und Technologie Apr. 1984 76 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-W-84-005; ISSN-0170-1339) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 16

A measurement system for the evaluation of radio navigation systems e.g., distance measurement equipment (DME)-derived azimuth system (DAS) is discussed. Subsystems comprise high precision trajectory generation, telemetry, data processing with real time display, multipath measurement, and traffic load simulation. A laser tracker, a tracking radar, and an inertial onboard navigation system were developed. A Kalman filter onboard the test aircraft was used for the integration of these sensors. Test flights show a position accuracy of 0.3 m and a speed accuracy of 0.01 m/sec. Author (ESA)

N84-28774# Technische Univ., Brunswick (West Germany). Inst. fuer Verkehr, Eisenbahnwesen und Verkehrssicherung.

INVESTIGATION OF THE TECHNOLOGY OF THE MICROWAVE LANDING SYSTEM TIME REFERENCE SCANNING BEAM (TRSB) Final Report, Mar. 1983

R. SPRINGER Bonn Bundesministerium fuer Forschung und Technologie Apr. 1984 85 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-W-84-008; ISSN-0170-1339) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18

A simulation model for a microwave landing system is examined. The time reference scanning beam (TRSB) system offers azimuth, elevation, and distance measuring for approach and landing. The simulation model enables the influence of interferences on the system under multipath conditions of difficult sites to be tested. Author (ESA)

N84-29281# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

SATELLITE DOPPLER POINT POSITIONING USING THE NAVY NAVIGATION SATELLITE SYSTEM

W. SCHLUETER In its Repts. on Cartography and Geodesy. Ser. 2: Translations, No. 40 p 23-97 1983 refs Presented at Lecture Ser., Wuhan, China, Nov.-Dec. 1981 Avail: NTIS HC A08/MF A01

The technique of Doppler point positioning using the U.S. Navy Navigation Satellite System is presented. The Navy Navigation Satellite System and geodetic receivers including the data output are described. Formulas for single point positioning and for (semi) short arc solutions are derived and refraction models are discussed. The data reduction concept using the program GEODOP is outlined. Author (ESA)

N84-29282# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

FINAL RESULTS OF DOPPLER POINT POSITIONING AT SEVERAL TIMEKEEPING LABORATORIES IN EUROPE

W. SCHLUETER and L. AMBERG In its Repts. on Cartography and Geodesy. Ser. 2: Translations, No. 40 p 99-107 1983 refs

Avail: NTIS HC A08/MF A01

At 21 stations in Europe point positioning was carried out using the Doppler technique. The observations of the satellites of the U.S. Navy Navigation Satellite System were performed in the period 6-16 November 1979. Coordinates computed with the precise ephemeris are given. Author (ESA)

N84-29289# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

DOPPLER OBSERVATION CAMPAIGN IN THE IVORY COAST: RECONNAISSANCE, MEASURING, INTERPRETATION AND EXPERIENCE Final Report [DIE DOPPLERMESSKAMPAGNE IN DER ELFENBEINKUESTE - ERKUNDUNG, MESSUNGSABLAUF, AUSWERTUNG UND ERFAHRUNGEN]

W. ETLING, P. MANTI, W. MUELLER, and E. REINHART In its Repts. on Cartography and Geodesy. Ser. 1: Original Repts., No. 91 p 25-48 1983 refs In GERMAN; ENGLISH and FRENCH summary

Avail: NTIS HC A05/MF A01

A satellite Doppler positioning network in the Republic of the Ivory Coast is described. The objectives were to set up a reference network for further surveying for planning and refinements of the infrastructure. The accuracy of the network, which includes 17 stations, is plus or minus 0.5 m. Author (ESA)

N84-29860# Institute for Defense Analyses, Alexandria, Va. Science and Technology Div.

AN/APN-128 LIGHTWEIGHT DOPPLER NAVIGATION SYSTEM (LDNS) CASE STUDY REPORT (IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY) STUDY Final Report, Jul. 1982 - Aug. 1983

P. F. GOREE Aug. 1983 185 p

(Contract MDA903-79-C-0018)

(AD-A142072; AD-E500641; IDA-D-23; IDA/HQ-83-25935) Avail: NTIS HC A09/MF A01 CSCL 17G

This document records the activities and presents the findings of the AN/APN-128 Lightweight Doppler Navigation System (LDNS) Case Study Working Group, part of the IDA/OSD Reliability and Maintainability Study conducted during the period from July 1982 through August 1983. GRA

N84-29861# Federal Aviation Administration, Washington, D.C. Office of Management Systems.

FAA (FEDERAL AVIATION ADMINISTRATION) AIR TRAFFIC ACTIVITY FY 1983 Report, 1 Oct. 1982 - 30 Sep. 1983

N. TREMBLEY 30 Sep. 1983 219 p

(AD-A142493) Avail: NTIS HC A10/MF A01 CSCL 17G

This report furnishes terminal and en route air traffic activity information of the National Airspace System. The data have been reported by the FAA-operated Airport Traffic Control Towers (ATCTs), Air Route Traffic Control Centers (ARTCCs), Flight Service Stations (FSSs), International Flight Service Stations (IFSSs), and Approach Control Facilities. GRA

N84-29862# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Anthropotechnik und Simulation.

DEFINITION AND LAYOUT OF A TRAFFIC GENERATOR FOR AN AIR TRAFFIC CONTROL SIMULATION

D. DIPPE and J. THOMAS Mar. 1984 86 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-888)

(DFVLR-FB-84-15; ESA-TT-888) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 29

An air traffic generator was developed and implemented as a computer program which produces realistic traffic samples. The concept is based on the analysis of real air traffic control (ATC) structures and traffic flows. In a Monte Carlo traffic generation process, statistically varied traffic samples are computed as a function of user selectable characteristics of a given scenario. The resultant flight plans and initial states for individual aircraft are directly used to drive a real time ATC simulation. The computation process is illustrated for a typical application. Author (ESA)

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A84-40047

APPLICATION OF THE CLEARWAYS CONCEPT TO THE DETERMINATION OF THE MAXIMUM TAKE-OFF WEIGHT [DIE ANWENDUNG DES KONZEPTS DER FREIFLAECHE AUF DIE ERMITTLUNG DER HOECHSTZULAESSIGEN STARTMASSE]

P. KORRELL (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 20, no. 2, 1984, p. 42-52, 70. In German. refs

Graphic and microcomputer techniques for calculating the MTOW from the take-off run available (TORA), the take-off distance available (TODA), and the accelerate-stop distance available (ASDA) are presented and demonstrated. The methods of obtaining the input data are discussed; the graphic technique is illustrated for sample problems; and the efficiency of an optimization algorithm based on the clearway parameter is shown in a series of typical printouts. Possible changes in runway design and regulations are considered on the basis of practical experience with the system.

T.K.

A84-40059

TOULOUSE - THE ATR-42 BEGINS ITS TRIALS [TOULOUSE - L'ATR-42 COMMENCE SES ESSAIS]

J. MORISSET Air et Cosmos (ISSN 0044-6971), June 30, 1984, p. 22-25. In French.

The twin turboprop powered ATR-42 is scheduled for flight tests in September 1984. The aircraft was produced through collaboration between French and Italian manufacturers and is intended as a 46 passenger commuter aircraft. Extensive use has been made of various composite materials for secondary structures. The ATR-42 also has a flight management computer and advanced CRT avionics displays. The take-off weight is 15,750 kg, including 4810 kg of cargo, and the runway distance is 1042 m. Certification is scheduled for late 1985. Drawings of all major aircraft components are provided.

M.S.K.

A84-40569

SIKORSKY'S HAWKS - HELICOPTERS FOR THE ARMY, THE NAVY AND THE AIR FORCE ... AMONGST OTHERS

Air International (ISSN 0306-5634), vol. 27, July 1984, p. 9-16, 45, 46.

Design, performance features, variations and missions of the Sikorsky Hawk series of helicopters are explored. Over a thousand UH-60s (Black Hawks) are on order or have been delivered to the Army for a combat role. The basic vehicle carries 11 troops, has a 2-3 hr flight endurance and cruises at 145 kt at 4000 ft. A modified version may be capable of 1100 n. mi. flight with added fuel pylons. Another variant, the EH-60A, will carry EW equipment. The S-70L (Sea Hawk) has a 10 percent more powerful engine and more corrosion protection and is used by the Navy and commercial organizations. The USAF has the Night Hawk rescue version and Black Hawks for combat. An expanding export market is envisioned during the later 1980s, with the UH-60s serving as cargo and passenger carriers.

M.S.K.

A84-40570#

WINGS OR NOT FOR A MISSILE?

R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 22, July 1984, p. 26-28.

The benefits and detriments of wings for guided missiles are discussed. Wings add maneuverability, a plus for antiaircraft weapons, which also benefit from the ability to fly at a lower angle of attack due to lift forces. The wingless missile may have less trim drag in cruise because of a further-forward center of

pressure and greater control effectiveness in the tail fins. Wings increase the weight, parts count, cost and burnout weight. The wingless missile has less drag at low lift, produces fewer shock waves and less skin friction. The choice of configuration is therefore mission(s)-dependent, the winged missile having less speed but better end-game maneuverability and the wingless missile being capable of reaching a target more quickly.

M.S.K.

A84-40571#

COMPOSITE HELICOPTER WEIGHS IN ONE-QUARTER LIGHTER

V. WIGOTSKY Aerospace America (ISSN 0740-722X), vol. 22, July 1984, p. 28, 30, 32.

Progress in the U.S. Army All Composite Airframe Program (ACAP) for fuselages for the next generation of helicopters is summarized. ACAP was initiated in 1979 to reduce airframe weight by 22 percent and cut cost by 17 percent while meeting all performance standards for metal aircraft. The S-75, to be flight tested in the summer of 1984, weighs 24 percent less and cuts costs 23 percent (predictions for production models). The S-75 is 80 percent graphite, Kevlar, fiberglass, Nomex honeycomb core and adhesives. It has a reduced radar cross section, resists fire from high explosives and is survivable at crash rates of 42 fps. Details of the locations and performance levels of the associated parts are provided, noting that static and flight tests are scheduled in the near future to compare the ACAP helicopter with its metal equivalent.

M.S.K.

A84-40575#

TILT-ROTOR - AN ODD MARRIAGE THAT WORKS

R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 22, July 1984, p. 66-68, 70.

Design features and progress with the XV-15 prototype for the JVX tilt-rotor aircraft are discussed. Tilt-rotors have all the benefits of helicopters and in addition less disk loading and noise, no hot gas ingestion, less ground erosion, no antitorque tail rotor and double airspeed. The XV-15 has metal wings with no aeroelastic instabilities and has displayed good stability in all flight modes. Twin T53 turbines are mounted for both vertical and horizontal operation. Tests are under way to examine digital controls to alleviate longitudinal gust accelerations and tail buffeting. The JVX is expected to go into production in the late 1980s. Performance figures are projected to be 12-24 passengers, 24 seats, 700 n. mi. range, 275 kt dash speed, 3000 ft hover at 33 C and an 8300 lb external payload.

M.S.K.

A84-40788

BLACK HAWK HOVER INFRARED SUPPRESSOR SUBSYSTEM

A. GUGLIELMO, R. BARNARD (United Technologies Corp., Sikorsky Aircraft, Stratford, CT), and W. STEYER (General Electric Co., Washington, DC) Vertiflite (ISSN 0042-4455), vol. 30, July-Aug. 1984, p. 40-44.

Design features and test results of a hover IR suppression system (HIRSS) for the UH-60A combat helicopter are described. The HIRSS was devised as a means to lower UH-60A IR emissions, which are a homing signal to heat-seeking missiles. A study program defined areas for modifications: screening hot engine parts, cooling visible exhaust system parts, minimizing reflected radiation from hot engine parts and diluting exhaust gases with ambient and compartment cooling air. Wind tunnel tests were performed on a scale model to ensure that the UH-60A aerodynamics remained steady with the kit components installed. Ground tests verified the reliability and durability of the added parts and qualification flights validated performance continuity and extinguisher functions.

M.S.K.

A84-40891

STRUCTURAL OPTIMIZATION OF AN AIRCRAFT DESIGN WITH CONSIDERATION OF AEROELASTIC FLUTTER STABILITY [STRUKTURELLE OPTIMIERUNG EINES FLUGZEUGENTWURFS UNTER BERUECKSICHTIGUNG AEROELASTISCHER FLATTERSTABILITAETSASPEKTE]

R. FREYMANN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, May-June 1984, p. 208-217. In German. refs

A computational algorithm for the minimum-weight optimization of aircraft structures is presented and demonstrated. The method takes both strength-determined scaling criteria and the flutter stability into account and makes use of modal characteristics derived from a reduced finite-element model of the structure. The results of a sample optimization on a cantilevered large-aspect-ratio wing model are presented in tables and graphs, and a flow chart of the algorithm is provided. T.K.

A84-41058

UTILIZATION OF THE B.AE. ADVANCED FLIGHT DECK

J. W. WILSON (British Aerospace, PLC, Aircraft Group, Hatfield, Herts., England) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 69-73.

The Advanced Flight Deck (AFD) assessment program started in 1975 as an evaluation of monochrome CRT displays. The program terminated in November 1979. A number of additions and modifications were introduced in preparation for a further program with color CRT displays. A description is provided of the projected programs. Displays are discussed, taking into account the number of displays, their size, aspects of format and color, questions of symbology, size C displays, stand-by instruments, display control, and flight trials. Aspects of data entry and retrieval are also considered along with voice warning, and flight deck documentation. G.R.

A84-41059

THE ROLE OF PILOTS AND AUTOMATION IN FUTURE TRANSPORT FLIGHT STATIONS

M. A. COMPANION and G. A. SEXTON (Lockheed-Georgia Co., Marietta, GA) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 75-92.

It is pointed out that transport flight stations are beginning to exhibit significant changes in design and appearance as compared to previous generation aircraft. Thus, CRTs are used in a number of new aircraft to display flight, navigation, and engine performance information. The use of advanced technology has also brought about increases in crew systems automation. The role of the crew is affected by these changes, and efficient two-person flight stations have been made possible. However, a number of questions arise in connection with the design of the new flight stations, and empirical studies are needed to answer them. In response to these problems, an advanced flight station program has been conducted by an American aerospace company. A crew system development approach is discussed taking into account an aircraft description and the ATC environment. Attention is given to design criteria, an overview of flight station design, and major flight station components which affect automation. G.R.

A84-41062

ADVANCED COMMERCIAL COCKPIT CONCEPTS

W. L. MILES, J. I. MILLER, and V. VARIAKOJIS (Douglas Aircraft Co., Long Beach, CA) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 103-123.

Recent developments in the cockpits of commercial transport aircraft are related to a digital autoflight guidance system, the introduction of the first production head-up display (HUD), the employment of electronic cathode-ray tubes (CRT) flight instruments, and engine/caution/warning displays. The present investigation is concerned with the reasons for the occurrence of these developments and with the final results which will be produced by the continuing changes in cockpit design. It is pointed out that two major developments combined in recent years to revolutionize flight deck technology. The first was the increase in large-scale integration (LSI) of electronic circuitry, while the second is related to the development of full color CRT's with adequate performance, size, reliability, and operability. Attention is given to the impact of new flight deck technology, flight deck design objectives and philosophy, a flight deck development approach, and the advanced commercial cockpit at an American aircraft manufacturer. G.R.

A84-41071

DESIGN AND FLIGHT TEST OF ONE-MAN OPERABILITY IN THE F/A-18

C. E. ROSENMAYER and M. J. TKACH (McDonnell Douglas Corp., St. Louis, MO) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 191-201.

The F/A-18 has the capability to perform a greater variety of fighter/attack missions than any other single-place aircraft ever produced. This paper will not address any new discussion of the 'one vs two' crewmember situation, but only present the human factors engineering history that produced the current man-machine interface in the F/A-18. The extensive software capability of the airplane has made changes found desirable during flight test reasonably easy to incorporate into production aircraft. These changes encompass everything from aircraft handling qualities and display formats (heads-down and heads-up) to radar and weapons system operation. Previous aircraft have depended, in varying degrees, on the unique capabilities of the pilot to compensate for inherent crew station/weapon system deficiencies. The Hornet, from its inception, has been designed to help the pilot expand upon his capabilities - to give him more and better help toward the ultimate objective of his weapon system. Author

A84-41080

THE IMPACT OF AUTOMATION ON FLIGHT TEST

G. H. LYDDANE (FAA, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 289-298.

The effect of automation on the FAA certification process is discussed. The new technology has increased the use of simulation in the development and certification of products. Examples of systems presented to the FAA for certification to which automation has been applied are described, including: Omega/VLF Navigation Systems, the DC-9-80 Head Up Display and Autoland Program, a Performance Management System, an Electronic Flight Instrument System, and an Engine Indicating Caution Warning System. C.D.

A84-41241**EH 101**

C. W. HAGUE (Westland Helicopters, Ltd., Yeovil, Somerset, England) Aerospace (UK) (ISSN 0305-0831), vol. 11, July-Aug. 1984, p. 17-26.

The EH 101 helicopter, powered by three engines rated at 1,725 shaft horsepower, is designed to have a cruise speed of 150 knots, a lift-off weight of 31,500 lb, and an operating altitude of 3,000 feet. The main rotor blades (which have an increased chord, a varying sweep back, and a forward extension), the tail rotor blades, and both hubs are of a composite construction. The helicopter is equipped with a three-part avionic system including aircraft management, automatic flight control, and display systems. The helicopter also incorporates autostabilization, autopilot, and digital systems. Flight development is based on nine aircraft and the first flight is scheduled for early 1987. J.P.

A84-41329#**INDUCED DRAG REDUCTION WITH WING TIP MOUNTED PROPELLERS**

J. L. LOTH and F. LOTH (West Virginia University, Morgantown, WV) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 8 p. refs

(AIAA PAPER 84-2149)

Techniques for converting the rotational kinetic energy in the wake of propellers to thrust are explored. The targets are the wingtip vortices which induce a downwash velocity, i.e., drag. It is suggested that mounting counter-rotating propellers, one to a wingtip, will transfer the downwash outboard of the wing and induce an upwash, i.e., lift, in the wing region. The concept has already been demonstrated by the XV-15 tilt rotor aircraft. The Biot-Savart law is used to calculate the velocity induced on the bound vortex by the propeller wake. Analytical comparisons are made of the inboard and outboard propeller thrust and compared against wind tunnel data. The induced thrust is shown to be feasible with small propellers with high disk loadings, although consideration of the weight penalty for added gearboxes and cross-shafting is needed in design work. M.S.K.

A84-41335#**DUAL AND SINGLE WING DESIGN INTEGRATION-OPTIMIZED FOR DECALAGE ANGLE, $R(E)$, AND $M(CR)$**

K. ROKHSZ and B. P. SELBERG (Missouri-Rolla, University, Rolla, MO) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 11 p. refs

(AIAA PAPER 84-2161)

Dual airfoil general aviation configurations are studied for medium speed applications with the new MS(1)-0313 airfoil section. Methods of analysis are discussed and validated through comparison with available experimental results. It is demonstrated that with proper selection of gap, stagger, decalage, and mission requirements total drag can be significantly reduced. Proper spanwise distribution of decalage is shown to enhance efficiency while raising the critical Mach number. Also correct choice flight conditions is shown to result in operation at the proper Reynolds number, reducing the viscous drag. Comparisons are made between optimized dual wing configurations and their equivalent single wing designs. In all cases, dual wing systems are proven superior to single wing designs. Author

A84-41336#**ON THE AERODYNAMIC OPTIMIZATION OF MINI-RPV AND SMALL GA AIRCRAFT**

F. R. GOLDSCHMIED American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 13 p. refs

(AIAA PAPER 84-2163)

A brief study has been carried out on the adaptation of an optimized system comprising an axisymmetric body, suction boundary-layer control and stern jet-propulsion, which was developed originally for lighter-than-air application, to mini-RPV and

small GA aircraft by the addition of dynamic wing lift. For mini-RPV, consideration has been given to fuselage diameters of 20 and 34 in. with a gross weight range from 125 to 300 lb at the speeds of 100 and 150 Kn. The predicted powers ranged from 2.35 to 16.20 HP. For the GA aircraft, consideration has been given to fuselage diameters of 45 and 60 in. with a gross weight range from 1400 to 3400 lb at the speed of 200 mph. The predicted powers ranged from 60.6 to 132.5 HP. Author

A84-41346*# Kentron International, Inc., Hampton, Va.**WING DESIGN WITH ATTAINABLE THRUST CONSIDERATIONS**

H. W. CARLSON (Kentron International, Inc., Hampton, VA), B. L. SHROUT, and C. M. DARDEN (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 8 p. refs

(AIAA PAPER 84-2194)

A CAD process that includes leading-edge thrust considerations for wings with high aerodynamic efficiencies is outlined. Rectangular grids are used for evaluation of both subsonic and supersonic pressure loadings. Account is taken of the Mach number, Re , the wing planform, the presence of camber, the airfoil geometry and the locations and forces induced by shed vortices. Optimization techniques are applied to the candidate surfaces in order to consider the attainable thrust. Inclusion of the optimization techniques permits analyses of mission-adaptive wings and various flap systems and the elimination of singularities in the flight envelope. M.S.K.

A84-41352*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.**ANALYSIS OF AXISYMMETRIC BODY EFFECTS ON ROTOR AERODYNAMICS USING MODIFIED SLENDER BODY THEORY**

G. K. YAMAUCHI and W. JOHNSON (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 19 p. refs

(AIAA PAPER 84-2204)

A modified slender body theory was used in modelling the flowfield around an axisymmetric body at zero angle of attack. The model was defined in an attempt to characterize body-induced effects on helicopter rotor performance and loading using efficient computation methods. The streamfunction for an axial source distribution was applied in the body model, which was then adapted to the helicopter analysis code (CAMRAD). The body-induced velocities were calculated for separate locations on the rotor disk. Three different rotor models in nonuniform inflow with a free wake geometry were considered. Comparison of predictions with data on ellipsoidal and axisymmetric bodies showed good agreement for moderately thick ellipsoidal bodies. Oscillatory blade bending moments were increased by the presence of the body, but overall performance impact was negligible. Computational efficiency was 10-20 percent better than with a potential flow panel code. M.S.K.

A84-41388**SOVIET HELICOPTERS: DESIGN, DEVELOPMENT AND TACTICS**

J. EVERETT-HEATH London, Jane's Publishing Co., Ltd., 1983, 190 p.

A development history is presented for Soviet rotary wing aircraft, including autogyros, with attention to their design and performance characteristics and their overwhelmingly military categories of employment. This history is dominated by the work of the design bureaus headed by Mikhail Mil and Nikolai Kamov, which have respectively produced most of the types employed by the Soviet Army and Navy. Since these and other design bureaus are primarily working for the armed forces, designers have consistently developed equipment that is serviceable during battle and that can be operated and maintained by officers and soldiers in the field, at night and in bad weather, with limited technical skills and repair facilities. Many of these characteristics are useful

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to Aeroflot helicopters operating in the rugged climate and terrain of the Soviet Union. O.C.

A84-41644

ENHANCEMENT OF THE EFFICIENCY OF THE SOLUTION OF GEOMETRIC PROBLEMS IN AIRCRAFT DESIGN AND PRODUCTION [RACIONALIZACE PRACE S GEOMETRII PRI VYVOJI A VYROBE LETOUNU]

D. SLAVETINSKY Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 11-18. In Czech.

The application of CAD techniques to the solution of geometric problems in aircraft design is discussed with particular emphasis on the use of the GL-3 programming system. The main syntactic features and simple applications of the GL-3 language are examined, and attention is given to the present status of the development of geometrical systems. B.J.

A84-41649

SYSTEM FOR THE AUTOMATIC COMPUTATION OF AIRCRAFT LOADING [SYSTEM AUTOMATIZACE VYPOCTU ZATIZENI LETOUNU]

R. BOHM Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 41-49. In Czech.

The paper briefly describes the SALVE system for the computation of aircraft loads. This system, developed and employed at LET, Uherske Hradiste-Kunovice, is examined with regard to basic principles, application possibilities, and user outputs. B.J.

A84-41653

SOLUTION TO THE PROBLEM OF THE DYNAMIC RESPONSE OF A WING BY DIRECT INTEGRATION [RESENI DYNAMIKY KRIDLA PRIMOU INTEGRACI]

V. BUCHTA Zpravodaj VZLU (ISSN 0044-5355), no. 2, 1984, p. 93-100. In Czech. refs

A method is developed for predicting the dynamic response of a wing under a vertical symmetrical gust. Finite elements are used for the discretization of the structure, and the corresponding ordinary differential equations of motion are obtained. These equations are solved by explicit single-step time integration, the Z-transformation being used to transform the results from the time domain to the frequency domain. B.J.

A84-41654

THE USE OF COMPUTER TECHNIQUES IN AIRCRAFT TESTING AT NP LET [VYUZITI VYPOCETNI TECHNIKY PRI ZKOUSKACH LETADEL V N.P. LET]

P. FIZEL and V. PACHL Zpravodaj VZLU (ISSN 0044-5355), no. 2, 1984, p. 101-106. In Czech.

The use of computer techniques to prepare aircraft-testing procedures and to evaluate test results at NP LET is examined. Particular attention is given to software for the digital measuring system of the SFIM and Schlumberger firms for data acquisition and processing. B.J.

A84-41657

THE USE OF COMPUTER TECHNIQUES FOR AIRCRAFT RELIABILITY ANALYSIS [UPLATNENI VYPOCETNI TECHNIKY PRI ANALYZE SPOLEHLIVOSTI LETOUNU]

B. KYSELY Zpravodaj VZLU (ISSN 0044-5355), no. 2, 1984, p. 123-127. In Czech. refs

The application of computer techniques in four areas of aircraft safety analysis is considered: (1) reliability information systems; (2) system reliability analysis; (3) system optimization; and (4) simulation of equipment operation. Also considered is the use of computer techniques to analyze the reliability of systems represented by a reliability block diagram. An advantage of the proposed approach is the possibility of simple and rapid formulation and solution of different variants of the analyzed system. B.J.

A84-41662

THE VYZLE PROGRAM PACKAGE - CALCULATION OF AIRCRAFT SERVICE LIFE [SYSTEM PROGRAMU VYZLE - VYPOCET ZIVOTA LETOUNU]

J. VLACHYNSKY Zpravodaj VZLU (ISSN 0044-5355), no. 3, 1984, p. 177-181. In Czech. refs

A program package for calculating safe life expectancy of aircraft components is described. The ASDR program is used to determine the biparametric distribution according to amplitudes and mean values on the basis of values of the spectrum of stresses, forces, or moments in the critical region. The ASUP program adds to this distribution fatigue damage according to different stress-number curves, and corrections for mean values and for the fatigue-test result. The ASBZ program determines the safe life expectancy. It is noted that the VYZLE package is particularly effective when operational strain-gage measurements are used as the input data. B.J.

A84-41663

CALCULATION OF THE RESPONSE OF AN AIRCRAFT TO THE FAILURE OF ONE ENGINE DURING THE TAKEOFF RUN [VYPOCET ODEZVY LETOUNU NA VYSAZENI JEDNE POHONNE JEDNOTKY PRI ROZJEZDU]

M. PESAK Zpravodaj VZLU (ISSN 0044-5355), no. 3, 1984, p. 183-189. In Czech. refs

The failure of one engine of a multiengine transport aircraft during the takeoff run is examined in detail with reference to the aerodynamic design stage. A method is proposed that includes the mathematical simulation of aircraft response to the engine failure as well as of pilot action directed toward restoring full controllability. It is shown that the preliminary minimum control speed can be calculated using the simulation results. B.J.

A84-41697

THE HIGH ACCELERATION COCKPIT (HAC) - A TECHNOLOGY BASE OVERVIEW

R. E. VAN PATTEN, T. J. JENNINGS (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), and M. MAXWELL (MCM Information Consultants, Dayton, OH) SAFE Journal, vol. 14, no. 2, 1984, p. 16-21. refs

Because of increasing load factors in high acceleration cockpit (HAC) aircraft, anti-G suits and anti-G suit valves, and oxygen systems are some of the pilot acceleration protection equipment which require improvement. Introduction of reclined seats may reduce hydrostatic loads on the pilot's cardiovascular system, and any proposed cockpit design involving controls, displays, anthropometry, restraints, and ejection systems should also take into account the fighter pilot's need for good aftward vision. A restraint and mobility test fixture (RMTF) has also been suggested to investigate aspects of seat back angle, advanced restraints, mobility and vision, and to facilitate pilot torso movements through the use of a swiveling seat back pan. Centrifuge testing is believed to be adequate for final design of any given application, taking into account the aerodynamic characteristics of the vehicle. In addition to advanced protective systems, other programs may begin the exploitation of human operator/bioelectronics. However, it may be important that the exploitation of future technologies assure the integration of man, machine, and weapon systems. J.P.

A84-41779#

COMPILATION AND APPLICATION OF A STATE-TIME SPECTRUM OF AIRCRAFT AMBIENT VIBRATION

Q. GONG (Nanchang Aircraft Manufacturing Co., Nanchang, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, March 1984, p. 24-29. In Chinese, with abstract in English.

This paper puts forward a compiling method of the state-time spectrum of aircraft ambient vibration. It is based on a great deal of statistical data taking both flight and ground tests into comprehensive consideration. Therefore, the state-time spectrum of aircraft ambient vibration drawn up by this method can give true expression of the aircraft practice. This method has found engineering application. Author

A84-42278

A COMPOSITE ROTOR SHAFT FOR THE CHINOOK

H. FAUST, J. MACK (Boeing Vertol Co., Philadelphia, PA), and B. SPENCER (Brunswick Corp., Defense Div., Lincoln, NE) American Helicopter Society, Journal (ISSN 0002-8711), vol. 29, July 1984, p. 54-58.

The aft rotor shaft whose design, testing and fabrication process is discussed, represents a noteworthy composite material application in a primary load path element that is subjected to fatigue. A glass and graphite filament-winding process was employed which involved both 90-deg and helical filament geometries, since analysis has shown that interlaminar stresses otherwise developed between the bending, or zero-deg, and shear, or + or - 45 deg plies, are kept to a minimum by dispersing the zero-deg fibers. A 200-percent increase in service life and a 20-percent weight reduction have been obtained. O.C.

A84-42348*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

SIMULATOR EVALUATION OF A REMOTELY PILOTED VEHICLE LATERAL LANDING TASK USING A VISUAL DISPLAY

S. K. SARRAFIAN (NASA, Flight Research Center, Edwards, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 218-230. refs (AIAA PAPER 84-2095)

A simulator evaluation of a remotely piloted research vehicle was conducted at NASA Ames Research Center's Dryden Flight Research Facility to determine the utility of a visual display when studying the influence of changes in the lateral-stick gearing gains during landing approaches. The test vehicle used in this study was a highly maneuverable aircraft technology (HiMAT) aircraft, which is a 0.44-scale version of an envisioned small, single-seat fighter airplane. Handling qualities ratings and comments obtained from pilots using a simulated visual display of a runway scene and a simulated instrument landing system (ILS) display were compared with the results of actual flight tests. The visual display was found to provide an adequate representation of the test vehicle in a visual landing approach, and it improved the roll response cues provided to the pilot. The handling qualities ratings and comments for flight and simulation visual landing approaches correlated well. The ILS simulation results showed reduced correlation compared with the flight results for ILS approaches. Handling qualities criteria for remotely piloted research vehicles are also discussed in this paper. Author

A84-42366*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

CLASSICAL AND NEO-CLASSICAL CRUISE-DASH OPTIMIZATION

E. M. CLIFF, H. J. KELLEY (Virginia Polytechnic Institute and State University, Blacksburg, VA), and K. D. BILIMORIA IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 424-433. refs (Contract NAG1-203) (AIAA PAPER 84-2125)

Cruise-dash flight performance is analyzed in the context of singular perturbations. Attention is given to the problem of determining an atmospheric flight path between given end points which minimizes a linear combination of time and fuel. It is shown that nonconvexity in the fuel-flow vs. airspeed graph has important consequences in optimum-cruise problems with time restrictions. Certain velocity regions are nonoptimal for cruise-dash and optimal cruise-dash sometimes requires time-shared operation between two altitude-airspeed points. Calculations are presented illustrating the occurrence of time-shared operation between two altitude-airspeed combinations for optimal cruise-dash. B.J.

A84-42370#

AN ALTERNATE AIRCRAFT TAKEOFF SYSTEM FOR TACTICAL AIRCRAFT

A. B. CLARK, III (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 458-464. refs (AIAA PAPER 84-2130)

Ten percent models of a tri-cell plenum air cushion launcher vehicle and an F-4E were tested together in a subsonic, surface effects wind tunnel to obtain aerodynamic force and moment data. This data was used as input into a dynamics simulation computer model to evaluate the stability characteristics of a simulated launch of an F-4E from an air cushion vehicle. Results of the wind tunnel tests indicated a high aerodynamic lift coefficient of 0.7 measured for the launcher. Significant aerodynamic interference of the F-4E on the launcher was also measured for high aircraft angles of attack. Results of the stability analysis indicated stable performance of the launcher/aircraft combination from zero speed to aircraft rotation speed. Major results of the wind tunnel tests and the subsequent stability analysis are presented. Author

A84-42371#

MISSION ADAPTIVE WING ADVANCED RESEARCH CONCEPTS

R. W. DECAMP (USAF, Wright-Patterson AFB, OH) and R. HARDY (Boeing Co., Seattle, WA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 465-470. (AIAA PAPER 84-2088)

The Mission Adaptive Wing research program is developing a smooth variable camber wing controlled by a dual digital fly-by-wire system. The camber is changed by bending the leading and trailing edges of the wing by internal hydraulic-actuated mechanisms, and the resulting lift/drag polar is a composite polar determined by aerodynamic characteristics of many individual fixed geometry wing cross-sections. The resulting performance improvement is considerable if the aircraft has to fly at several different lift coefficients. The improvement in L/D ratio for the AFTI/F-III is illustrated as compared to an aircraft with the TACT wing flight-tested in 1975. The various automatic modes are examined, including maneuver camber control, cruise camber control, maneuver enhancement/gust alleviation, and maneuver load control. B.J.

A84-42569

THE AEROELASTIC WING - IMPROVED PERFORMANCE THROUGH USE OF ANISOTROPIC MATERIALS [DER AEROELASTISCHE FLUEGEL - LEISTUNGSGEWINN DURCH EINSATZ ANISOTROPER WERKSTOFFE]

M. PIENING (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Strukturmechanik, Brunswick, West Germany) DFVLR-Nachrichten (ISSN 0011-4901), vol. 42, June 1984, p. 10-13. In German.

The use of anisotropic materials to exploit the aerodynamic advantages of forward-swept wings (FSW) and other advanced designs is discussed. A simplified torsion-beam model of the anisotropic wing is developed, the advantages of the FSW and the difficulties involved in realizing it are examined, and the use of aerodynamic tailoring techniques to determine the direction and thickness of composite laminates needed to achieve the required degree of bending-torsion coupling is illustrated graphically. Current work at the DFVLR Institut fuer Strukturmechanik is focused on the development of a multiple-shooting program to compute the properties of wings of arbitrary geometry and loading conditions. T.K.

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N84-28775*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AEROSPACE ENGINEERING DESIGN BY SYSTEMATIC DECOMPOSITION AND MULTILEVEL OPTIMIZATION

J. SOBIESZCZANSKI-SOBIESKI, J. F. M. BARTHELEMY (Virginia Polytechnic Inst. and State Univ.), and G. L. GILES Jun. 1984 15 p refs Proposed for presentation at the 14th Congr. of the International Council of the Aeronautical Sciences (ICAS), Toulouse, 10-14 Sep. 1984

(NASA-TM-85823; NAS 1.15:85823) Avail: NTIS HC A02/MF A01 CSCL 01C

A method for systematic analysis and optimization of large engineering systems, by decomposition of a large task into a set of smaller subtasks that is solved concurrently is described. The subtasks may be arranged in hierarchical levels. Analyses are carried out in each subtask using inputs received from other subtasks, and are followed by optimizations carried out from the bottom up. Each optimization at the lower levels is augmented by analysis of its sensitivity to the inputs received from other subtasks to account for the couplings among the subtasks in a formal manner. The analysis and optimization operations alternate iteratively until they converge to a system design whose performance is maximized with all constraints satisfied. The method, which is still under development, is tentatively validated by test cases in structural applications and an aircraft configuration optimization. Author

N84-28776*# Boeing Commercial Airplane Co., Seattle, Wash. **DEVELOPMENT OF INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN (IPAD). IPAD USER REQUIREMENTS: IMPLEMENTATION (FIRST-LEVEL IPAD)**

12 Mar. 1980 100 p refs

(Contract NAS1-14700)

(NASA-CR-162713; NAS 1.26:162713; D6-IPAD-70016-D-1)

Avail: NTIS HC A05/MF A01 CSCL 01C

The requirements implementation strategy for first level development of the Integrated Programs for Aerospace Vehicle Design (IPAD) computing system is presented. The capabilities of first level IPAD are sufficient to demonstrate management of engineering data on two computers (CDC CYBER 170/720 and DEC VAX 11/780 computers) using the IPAD system in a distributed network environment. M.A.C.

N84-28777*# Boeing Commercial Airplane Co., Seattle, Wash. **NACELLE AERODYNAMIC AND INERTIAL LOADS (NAIL) PROJECT Summary Report, Oct. 1979 - Aug. 1981**

Washington NASA Jun. 1982 26 p refs

(Contract NAS1-15325)

(NASA-CR-3585; NAS 1.26:3585; D6-51141) Avail: NTIS HC A03/MF A01 CSCL 01C

Inlet airloads were measured by integration of pressures recorded at 252 locations on the right hand inboard (JT9D-7A) nacelle of the Boeing 747 aircraft. Pressures were recorded at 45 locations on the right hand outboard nacelle for comparison. Inertial loads were measured on both nacelles using accelerometers and rate gyros. Flight conditions included takeoffs at several gross weights, high g turns, and a simulated acceptance flight. Airloads at takeoff rotation were found to be larger than at any other normal service condition because of the combined effects of high angle of attack and high engine airflow. Inertial loads were smaller than previous estimates had indicated. A procedure is given for estimating inlet airloads at low speeds and high angles of attack for any underwing high bypass ratio turbofan installation approximately resembling the one tested. Flight procedure modifications are suggested that may result in better fuel economy retention in service. Pressures were recorded on the core cowl and pylons of both engine installations and on adjacent wing surfaces for use in development of computer codes for analysis of installed propulsion system aerodynamic drag interference effects. A.R.H.

N84-28778*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.

AIRCRAFT SURFACE COATINGS Final Contractor Report, Jan. 1980 - Feb. 1982

Jun. 1982 164 p refs

(Contract NAS1-15325)

(NASA-CR-165928; NAS 1.26:165928; D-49355) Avail: NTIS HC A08/MF A01 CSCL 01C

Liquid, spray on elastomeric polyurethanes are selected and investigated as best candidates for aircraft external protective coatings. Flight tests are conducted to measure drag effects of these coatings compared to paints and a bare metal surface. The durability of two elastomeric polyurethanes are assessed in airline flight service evaluations. Laboratory tests are performed to determine corrosion protection properties, compatibility with aircraft thermal anti-icing systems, the effect of coating thickness on erosion durability, and the erosion characteristics of composite leading edges-bare and coated. A cost and benefits assessment is made to determine the economic value of various coating configurations to the airlines. M.A.C.

N84-28779*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AN EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE AERODYNAMIC CHARACTERISTICS OF A BIPLANE-WINGLET CONFIGURATION M.D. Thesis

P. D. GALL Jun. 1984 97 p refs

(NASA-TM-85815; NAS 1.15:85815) Avail: NTIS HC A05/MF A01 CSCL 01C

Improving the aerodynamic characteristics of an airplane with respect to maximizing lift and minimizing induced and parasite drag are of primary importance in designing lighter, faster, and more efficient aircraft. Previous research has shown that a properly designed biplane wing system can perform superiorly to an equivalent monoplane system with regard to maximizing the lift-to-drag ratio and efficiency factor. Biplanes offer several potential advantages over equivalent monoplanes, such as a 60-percent reduction in weight, greater structural integrity, and increased roll response. The purpose of this research is to examine, both theoretically and experimentally, the possibility of further improving the aerodynamic characteristics of the biplanes configuration by adding winglets. Theoretical predictions were carried out utilizing vortex-lattice theory, which is a numerical method based on potential flow theory. Experimental data were obtained by testing a model in the Pennsylvania State University's subsonic wind tunnel at a Reynolds number of 510,000. The results showed that the addition of winglets improved the performance of the biplane with respect to increasing the lift-curve slope, increasing the maximum lift coefficient, increasing the efficiency factor, and decreasing the induced drag. A listing of the program is included in the Appendix. Author

N84-28780*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IMPROVING THE EFFICIENCY OF SMALLER TRANSPORT AIRCRAFT

R. T. JONES Jul. 1984 10 p refs

(NASA-TM-85992; A-9831; NAS 1.15:85992) Avail: NTIS HC A02/MF A01 CSCL 01C

Considered apart from its propulsive system the high altitude airplane itself adapted to higher flight altitudes than those in current use. Scaling on the assumption of constant aircraft density indicates that this conclusion applies most importantly to smaller transport aircraft. Climb to 60,000 ft could save time and energy for trips as short as 500 miles. A discussion of the effect of winglets on aircraft efficiency is presented. A 10% reduction of induced drag below that of a comparable elliptic wing can be achieved either by horizontal or vertical wing tip extensions. B.G.

N84-28781# Air Force Flight Test Center, Edwards AFB, Calif.
STORES WEIGHT AND INERTIA SYSTEM UPDATE: CABLE ATTACHMENT REDESIGN, FLEXIBLE LENGTH PARAMETER CALIBRATION, DATA SHEET REVISION Final Report, Oct. 1983 - Feb. 1984

K. J. WONG Feb. 1984 24 p
 (AD-A141087; AFFTC-TIM-84-1) Avail: NTIS HC A02/MF A01 CSCL 01C

This memo describes several changes implemented to the SWIS facility since publication of AFFTC-TIM-77-1. This includes a redesign of the cable attachments, a new length calibration method resulting in a figure of 177.1 in, and a proposed data recording sheet. Examples are presented to aid the user in operational and calibration data reduction. Author (GRA)

N84-28782# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
A MODEL OF ROTOR BLADE FIRST NATURAL FLAPPING RESPONSE FOR UP TO THREE/REV EXCITATIONS Final Report

J. B. WILKERSON Dec. 1983 26 p
 (Contract ARPA ORDER 4238)
 (AD-A141725; DTNSRDC/ASED-83/09) Avail: NTIS HC A03/MF A01 CSCL 01C

Thus far, all performance calculations for the X-Wing vertical takeoff concept have used a rigid, nonflapping blade analysis. At this stage in the concept development, the flapping degree of freedom should be included for increased accuracy. Thus, a relatively simple set of equations is developed to relate rotor blade aerodynamic moments and blade flapping response which provides rapid evaluation of the blade dynamics and the resulting changes in aerodynamic loading. The relationships between the aerodynamic hinge members and the blade response are derived for the first three harmonics of flapping. Changes in flap damping due to flapping response are accounted for in the equations, which are solved using standard matrix algebra. The equations are validated by comparison with a more sophisticated analytical technique. A case is examined for the critical conversion advance ratio, and the first-order dynamic response is shown for a range of blade natural frequencies. It is shown that a blade natural frequency higher than 2-per-day is desired. Author (GRA)

N84-28783# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
ACTIVE SUPPRESSION OF AEROELASTIC INSTABILITIES FOR FORWARD SWEEP WINGS Final Report, Jan. 1982 - Dec. 1983

T. E. NOLL, F. E. EASTEP, and R. A. CALICO Dec. 1983 170 p
 Previously announced in IAA as A84-24106
 (Contract AF PROJ. 2401)
 (AD-A141739; AFWAL-TR-84-3002) Avail: NTIS HC A08/MF A01 CSCL 01A

Analytical studies are conducted to investigate the potential of using active feedback control systems for preventing multiple aeroelastic instabilities (in close proximity) from occurring within the flight envelope of an advanced forward swept wing aircraft. With the addition of wing mounted external stores, the classical bending/torsion flutter instability is driven to lower airspeeds into the vicinity of the aeroelastic instabilities more commonly associated with a forward swept wing (divergence or body freedom flutter). For these studies a typical forward swept wing configuration, adversely mass ballasted to create the dynamic characteristics similar to those caused by adding external stores, is investigated. The goal of this study is to establish concept feasibility so that the technology can be considered for future aircraft application during a design as an alternative or option for preventing aeroelastic instabilities. Analyses are conducted to design active systems for the forward swept wing, cantilevered, free in rigid pitch only, and free in rigid pitch and plunge. They are designed such that both aeroelastic instabilities are suppressed simultaneously to a velocity 20 percent above the unaugmented bending torsion flutter speed with gain margins of at least + or - 6db at this speed conditions.

Obtaining large phase margins is also taken into consideration during the design analyses. GRA

N84-28784# Naval Postgraduate School, Monterey, Calif.
THE EFFECT OF COMPONENT REDUNDANCY UPON AIRCRAFT COMBAT SURVIVABILITY M.S. Thesis

A. J. KANGALOS Dec. 1983 63 p
 (AD-A141815) Avail: NTIS HC A04/MF A01 CSCL 01C

Aircraft combat survivability has developed into a discipline of its own. This thesis presents a brief overview of the two integral parts of survivability, susceptibility and vulnerability. It examines the probability of an aircraft being killed given a single shot fired by the enemy. It further examines the redundancy of critical components and the effect redundancy has on the probability of kill of the aircraft. Several numerical examples are given. The thesis also examines the Antiaircraft Artillery Simulation Computer Program, and the modifications required in order to introduce component redundancy into it are developed. GRA

N84-28785# Garrett Corp., Los Angeles, Calif. Aircsearch Manufacturing Div.

AIRCRAFT FUEL TANK INERTING SYSTEM Final Report, 8 May 1978 - 30 Jul. 1983

R. L. JOHNSON and J. B. GILLERMAN Wright-Patterson AFB, Ohio AFWAL Jul. 1983 267 p
 (Contract F33615-77-C-2023; AF PROJ. 2348)
 (AD-A141863; AFWAL-TR-82-2115) Avail: NTIS HC A12/MF A01 CSCL 01C

The program successfully demonstrated the feasibility of using permeable-membrane, hollow fibers to generate an inert gas to protect the aircraft fuel system against fire and explosion induced by natural sources or combat. The initial contract requirements included a flight demonstration of an onboard inert gas generator system (OBIGGS) using an Air Force KC-135A aircraft. The design of an inert gas generator (IGG) is highly dependent on the flight profile, engine characteristics, and fuel system designs. Mission analysis translated these parameters into an 8 lb/min inert gas generator that produced less than 9-percent oxygen. A life-cycle cost (LCC) analysis compared the state-of-the-art liquid nitrogen (LN2) system utilized on the C-5A aircraft against the IGG system designed for the KC-135A. Results showed the IGG system reduced LCC by 60 percent. Further, the IGG system eliminates the logistic constraints imposed by the use of LN2, thus allowing unrestricted deployment of the aircraft. A second LCC analysis was conducted in which the permeable-membrane system was compared against the blue foam design used on the C-130 aircraft. The LCC analysis shows great advantage for OBIGGS over blue foam. The externally pressurized polymethylene hollow fiber bundles are expected to exceed the 20-year life expectancy of the aircraft. GRA

N84-29863*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

FLIGHT CHARACTERISTICS OF A MANNED, LOW-SPEED, CONTROLLED DEEP STALL VEHICLE Final Report

A. G. SIM Aug. 1984 10 p refs Presented at the AIAA Atmospheric Flight Mech. Conf., Seattle, 21-23 Aug. 1984
 (NASA-TM-86041; H-1242; NAS 1.15:86041) Avail: NTIS HC A02/MF A01 CSCL 01C

A successful manned, low speed, controlled deep stall flight research program was conducted at NASA Ames Research Center's Dryden Flight Research Facility. Piloting techniques were established that enabled the pilot to attain and stabilize on an angle of attack in the 30 deg to 72 deg range. A flight determined aerodynamic data base was established for angles of attack as high as 72 deg. Poor lateral directional flying qualities were encountered at angles of attack above 60 deg. Insight into the high angle of attack lateral directional dynamics was gained through a basic root locus analysis. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

N84-29864*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

FIELD REPAIR OF AH-16 HELICOPTER WINDOW CUTTING ASSEMBLIES

L. J. BEMENT May 1984 24 p
(NASA-TM-85831; NAS 1.15:85831) Avail: NTIS HC A02/MF A01 CSCL 01C

The U.S. Army uses explosively actuated window cutting assemblies to provide emergency crew ground egress. Gaps between the system's explosive cords and acrylic windows caused a concern about functional reliability for a fleet of several hundred aircraft. A field repair method, using room temperature vulcanizing silicone compound (RTV), was developed and demonstrated to fill gaps as large as 0.250 inch.

N84-29865# General Dynamics Corp., Fort Worth, Tex.

DURABILITY METHODS DEVELOPMENT, VOLUME 7 Final Report, Jun. 1979 - Jan. 1984

S. D. MANNING, S. M. SPEAKER, D. E. GORDON, J. N. YANG (George Washington Univ., Washington, D.C.), and M. SHINOZUKA (Modern Analysis, Inc., Ridgewood, N.J.) Wright-Patterson AFB, Ohio AFFDL Jan. 1984 222 p
(Contract F33615-77-C-3123)
(AD-A142400; AFFDL-TR-79-3118-VOL-7) Avail: NTIS HC A10/MF A01 CSCL 20K

A statistically-based durability analysis methodology is evaluated, refined and demonstrated in this report for advanced metallic airframes. This methodology can be used to: (1) analytically assure the U.S. Air Force's durability design requirements, (2) evaluate durability design tradeoffs, and (3) evaluate structural maintenance requirements and user options affecting life-cycle costs. The methodology accounts for initial fatigue quality, crack growth accumulation in a population of structural details, load spectra and structural properties. Analytical procedures and guidelines are developed and described for quantifying the extent of damage due to fatigue cracking in structural details as a function of service time and design variables. An initial fatigue quality model is described and discussed. This model is based on the time-to-crack-initiation (TTCI) and the equivalent initial flaw size (EIFS) concepts and a deterministic crack growth power law. An experimental test program and the resulting fractographic data for cracks in clearance-fit fastener holes are described and discussed. GRA

N84-29866# General Dynamics Corp., Fort Worth, Tex.

USAF DURABILITY DESIGN HANDBOOK: GUIDELINES FOR THE ANALYSIS AND DESIGN OF DURABLE AIRCRAFT STRUCTURES Final Report, Jul. 1981 - Jan. 1984

S. D. MANNING, J. N. YANG (George Washington Univ., Washington, D.C.), and M. SHINOZUKA (Modern Analysis, Inc., Ridgewood, N.J.) Wright-Patterson AFB, Ohio AFWAL Jan. 1984 212 p
(Contract F33615-77-C-3123)
(AD-A142424; AFWAL-TR-83-3027) Avail: NTIS HC A10/MF A01 CSCL 01C

This is the first edition of the Durability Design Handbook. Objectives of the handbook are: (1) summarize and interpret the essential U.S. Air Force Durability Design requirements for metallic airframes, (2) provide durability analysis criteria for economic life and durability critical parts, (3) provide state-of-the-art durability analysis concepts and methods for quantifying the extent of damage for a population of details (e.g., fastener holes, fillets, cutouts, lugs, etc.) as a function of time, and (4) provide guidelines and design data for implementing the durability methodology and for assisting contractor and USAF personnel in complying with the intent of the durability specifications for metallic airframes. This document, loosely called a Handbook, provides guidelines, concepts, analytical tools and the framework for incorporating future durability methodology advancements and design data. GRA

N84-29867# Air Force Systems Command, Eglin AFB, Fla.

WEAPONS FILE

L. DEIBLER and L. ROESLER 1984 96 p Supersedes AD-A126656
(AD-A142508; AD-E800952) Avail: NTIS HC A05/MF A01 CSCL 15C

This Weapons File has been prepared by AD/XRP to provide unclassified technical data on air launched weapons and munitions. The file is broken into four major categories: Air-to-Air Missiles, Guided Weapons, Unguided Weapons and Submunitions. A more detailed classified Weapons Catalogue is also available which provides performance data. The data under AIRCRAFT indicates a typical loadout as configured for the Nonnuclear Armament Plan (NAP). This file has been computerized for easy updating and it is our intent to expand and update this file on an annual basis; therefore, your comments on improvements would be appreciated, and should be directed to Mr. Larry Roesler or Mr. Lynn Deibler, AD/XRPT, Eglin AFB, FL 32542. GRA

N84-29868# Simula, Inc., Tempe, Ariz.

DESIGN AND DEVELOPMENT OF AN AUTOMATICALLY CONTROLLED VARIABLE-LOAD ENERGY ABSORBER Final Report

J. C. WARRICK and J. W. COLTMAN Mar. 1984 71 p
(Contract N62269-82-C-0254)
(AD-A142683; TR-83-423; NADC-82025-60) Avail: NTIS HC A04/MF A01 CSCL 01C

The feasibility of an automatically controlled variable-load hydraulic energy absorber for use in crashworthy seating systems was investigated. In contrast to other systems, this model contained an acceleration-sensing device capable of automatic control to compensate for difference in occupant weight. A series of dynamic crash tests were performed in which the hardware successfully decelerated weights representing those of the 5th- through 95th-percentile occupants to a predetermined constant acceleration. The system was also prepared to a previously developed variable-load energy absorber system in terms of size, weight, cost, reliability, and accuracy. The program concluded that the automatically controlled variable-load energy absorber is capable of providing a predetermined constant deceleration, but recommends further testing with human surrogates to verify the capability of properly protecting human occupants from spinal injury. GRA

N84-29869# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

IMPROVED PILOT MODEL FOR APPLICATION TO A COMPUTER FLIGHT TESTING PROGRAM FOR HELICOPTERS

H. HAVERDINGS 26 Aug. 1983 31 p refs Presented at 9th European Rotorcraft Forum, Stress, Italy, 13-15 Sep. 1983 Sponsored by Royal Netherlands Air Force Directorate of Material Air
(NLR-MP-83052-U) Avail: NTIS HC A03/MF A01

A computer flight testing program for evaluation of helicopter dynamics and handling and control qualities was developed. A control model to fly the mathematical helicopter model was designed for maneuvering flight. The model was refined to improve controllability so as to be able to keep state variable deviations small during a maneuver. This required augmentation of the cost function (to be optimized) by specifying weighting terms on control rate and on the control and the state as well. Terminal conditions have to be met approximately, rather than exactly, so as to eliminate the problem of the pilot's feedback gains becoming infinitely large. Results of an application for a landing flare with an S-61 class helicopter are shown. Author (ESA)

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A84-40134

DATA-MEASURING SYSTEMS FOR FLIGHT TESTING OF FIXED WING AND ROTARY WING AIRCRAFT [INFORMATSIONNO-IZMERITEL'NYE SISTEMY DLIA LETNYKH ISPYTANII SAMOLETOV I VERTOLETOV]

A. M. ZNAMENSKAIA, P. S. LIMAR, and V. P. SHVEDOV Moscow, Izdatel'stvo Mashinostroyeniye, 1984, 152 p. In Russian. refs

Several systems and methods of measuring aircraft performance in flight tests are described. Attention is given to systems which monitor several physical parameters of aircraft performance including altitude, airspeed, internal pressure, temperature, vibration, stability, angle of attack and meteorological conditions. General principles of instrument design, and the basic characteristics of measurement information systems are also described. The range of error of several instrument systems is discussed. I.H.

A84-40393

A 60 GHZ OBSTRUCTION WARNING RADAR FOR HELICOPTERS [EIN 60 GHZ HINDERNISWARNRADAR FUER HUBSCHRAUBER]

H-G. WIPPICH, H. MEINEL, and W. FRANK (Telefunken AG, Ulm, West Germany) IN: Radar technology 1983; Symposium, 5th, Munich, West Germany, November 8-10, 1983, Reports. Duesseldorf, West Germany, Deutsche Gesellschaft fuer Ortung und Navigation, 1983, p. 32.1-32.21. In German. refs

It is pointed out that the helicopter becomes increasingly important as a flexible means of transportation. However, accidents have occurred repeatedly in cases involving the employment of the helicopter in difficult missions at low flight altitudes. The most frequent cause of the accidents is a collision with obstacles, in particular with high-voltage lines and cableways. This situation provided the motivation for the development of a 60 GHz pulse radar for overhead wire detection. Compared to other means for the detection of obstructions, such as high-voltage lines, the employment of radar has a number of advantages. Attention is given to the reasons for the selection of the considered frequency range, system considerations, the system concepts, aspects of signal evaluation, the provided display, the subsystems of the collision warning radar, and field measurements. G.R.

A84-40869

LASER ACCELEROMETERS IN AERIAL GRAVIMETRY SYSTEMS [LAZERNYI AKSELEROMETR AVIATIONNOI GRAVIMETRICHESKOI SISTEMY]

E. N. BEZVESILNAIA (Kievskii Politekhnikeskii Institut, Kiev, Ukrainian SSR) Kvantovaya Elektronika (ISSN 0368-7155), no. 26, 1984, p. 38-45. In Russian. refs

The feasibility of using laser accelerometers as gravimeters in aerial gravimetry systems is demonstrated. The corresponding equations of motion are obtained, and block diagrams of the principal components of a gravimetry system are presented. A comparative analysis is made of the performance of several aerial gravimetry systems developed in the Soviet Union and the USA. V.L.

A84-41061

ADVANCED TECHNOLOGY IN THE FLIGHT STATION

M. F. LEFFLER (Lockheed-California Co., Burbank, CA) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 97-101.

Lockheed is currently involved in research and development efforts aimed at applying new concepts to the flight station. TriStar One, Lockheed's flight test L-1011, is flying a trial installation of

color electronic displays on a portion of its instrument panel. Modifications made to the L-1011 Flight Management System control the arrival of the aircraft at its destination to an exact time. This presentation describes the evolutionary process that has led to the development of airborne digital systems and the integration of new emerging technologies such as color electronic displays into the cockpit. Development of these and other concepts will provide payoffs in the areas of flight safety, fuel conservation, and improved terminal area operations. Author

A84-41063

ADVANCEMENTS IN CONTROL/DISPLAY SYSTEMS FOR ARMY HELICOPTERS

F. J. BICK (U.S. Army, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 127-132.

Design strategies for improving Army helicopter crew stations are discussed. The improvements will be incorporated into the next generation of Army scout/observation helicopters as part of the Army Helicopter Improvement Program (AHIP). Specific crew station design innovations are discussed in detail and some areas for future research in improving helicopter control/display systems are identified. Among the improvements discussed are: multifunction integrated displays, data entry keyboards, redundant mission computers, and symbol generators. The integrated functions of these systems are: communication control and display; radar altitude; navigation; air data; stability and control augmentation; fault detection and location; caution/warning and advisory displays; engine condition monitoring; and mast mounted sight (MMS) sensor control and display. Diagrams of a few sample systems are provided. I.H.

A84-41065

DIGITAL MOVING MAP DISPLAY

D. DEMYER (Lear Siegler, Inc., Instrument Div., Grand Rapids, MI) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 143-150.

Results of studies of the feasibility of designing a Digital Moving Map Display for aircraft cockpits are presented. The work was done under the sponsorship of the USAF Flight Dynamics Laboratory and was intended to evaluate the effects of color, declutter, scaling (zoom), map orientation (north-up and track-up), and to quantify the digital storage and processing requirements of such a system. It is found that the system could provide highly detailed images at very low processing times (100 nanoseconds per pixel) and that this falls within the state-of-the-art. I.H.

A84-41068

AUTOMATION OF THE FLIGHT PATH - THE DISPLAY REQUIRED

J. G. OLIVER, M. R. HOAGLAND, and G. J. TERHUNE (Air Line Pilots Association-International, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 165-168.

Basic requirements for an instrument display for monitoring a CAT IIIB automatic approach, landing, and rollout are presented. The increasing sophistication of autopilot machines has caused concern over the role of the pilot in performing difficult flight procedures. Without adequate information, it has become difficult for pilots to decide when it is necessary to take over manual control of the aircraft. The head-up display system described would provide the pilot with constantly updated information on position, vector, and energy status of the aircraft as it begins an approach, landing, or rollout in conditions of poor visibility. It is expected that the recommendations of ALPA pilots will be incorporated into the design of flight deck displays on commercial aircraft in the future. I.H.

06 AIRCRAFT INSTRUMENTATION

A84-41069

COLOR CRT DISPLAYS - A NEW STANDARD FOR FLIGHT INSTRUMENTATION?

D. W. ISTWAN (Air Line Pilots Association International, Washington, DC) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition; Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 169-181. refs

Performance specifications for aircraft instruments with CRT displays are discussed, with emphasis on human factors and cockpit environment requirements. It is shown that the complexity of cockpit requirements can result in the development of hardware with specifications derived from a deficient human factors data base. The consequences of such a situation can be severe, including inadequate performance under demanding environmental conditions, increased costs, and reduced life penalties. It is pointed out that dependence on CRT technology for information critical to flight safety should be tempered with redundant conventional instrumentation until performance standardization is achieved.

I.H.

N84-28786# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

DIGITAL MULTIVARIABLE TRACKER CONTROL LAWS FOR THE KC-135A M.S. Thesis

W. J. LOCKEN Dec. 1983 250 p

(AD-A141118; AFIT/GE/EE/83D-40) Avail: NTIS HC A11/MF A01 CSCL 01D

Multivariable design technique, developed by Prof. Brian Porter of the Univ. of Salford, England, are used to develop digital control laws for the KC-135A. Control laws are developed for each of three diverse flight conditions. MULTI, a computer program used in the design, is modified to account for computational time delay. The effects of a computational time delay on the controllers developed are presented. The controllers developed, using these techniques, use output feedback with proportional plus integral control. Because of the structure of the system, measurement variables, in addition to the outputs, are necessary. A reduced controller is modeled by setting some of the required feedback gains to zero. A comparison of the results of the reduced controller to the complete controller is presented. A robustness controller is tested by performing specific maneuvers at more than one flight condition. The robust controller is of the reduced form and is required to perform under the constraints of the computational time delay. This thesis concludes that actuator dynamics play a significant role in the development of control laws and, as a result, 2nd order or higher actuator models should be used in future studies.

GRA

N84-28787# Dikewood Industries, Inc., Albuquerque, N. Mex. **DESIGN OF INCIDENT FIELD B-DOT SENSOR FOR THE NOSE BOOM OF NASA F-106B AIRCRAFT Final Report, Jun. - Dec. 1983**

D. V. GIRI and S. H. SANDS Kirtland AFB, N. Mex. AFWL Apr. 1984 71 p Prepared in cooperation with LuTech, Inc., Hayward, Calif.

(Contract F29601-82-C-0027; AF PROJ. 3763)

(AD-A141765; AFWL-TR-83-141) Avail: NTIS HC A04/MF A01 CSCL 14B

This report deals specifically with the design considerations of including a B-dot sensor on the existing nose boom of the NASA Langley Research Center experimental F-106B aircraft. Although mounting the B-dot sensor on the existing boom may not be the ideal location, time and aerodynamic constraints require a consideration of sensor placement on the boom. This report also analyzes the performance of a B-dot sensor on the existing boom. The objective of the B-dot sensor is to enable a measurement of the incident B-dot field in the direction of the aircraft axis, in a flyby configuration near the ATHAMAS II (VPD-II) facility. Selected scale-model data useful in supporting the sensor design are included in Appendix B.

Author (GRA)

N84-29870*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF ICING CLOUD INSTRUMENTS FOR 1982-1983 ICING SEASON FLIGHT PROGRAM

R. F. IDE and G. P. RICHTER 1984 26 p refs Presented at the 22nd Aerospace Sci. Meeting, Reno, Nev., 9-12 Jan. 1984; sponsored by the American Inst. of Aeronautics and Astronautics Prepared in cooperation with Army Research and Technology Labs.

(NASA-TM-83569; E-1950; NAS 1.15:83569;

USAAVSCOM-TR-84-C-1) Avail: NTIS HC A03/MF A01 CSCL 01D

A number of modern and old style liquid water content (LWC) and droplet sizing instruments were mounted on a DeHavilland DHC-6 Twin Otter and operated in natural icing clouds in order to determine their comparative operating characteristics and their limitations over a broad range of conditions. The evaluation period occurred during the 1982-1983 icing season from January to March 1983. Time histories of all instrument outputs were plotted and analyzed to assess instrument repeatability and reliability. Scatter plots were also generated for comparison of instruments. The measured LWC from four instruments differed by as much as 20 percent. The measured droplet size from two instruments differed by an average of three microns. The overall effort demonstrated the need for additional data, and for some means of calibrating these instruments to known standards.

Author

N84-29871*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

USER'S MANUAL FOR A FUEL-CONSERVATIVE DESCENT PLANNING ALGORITHM IMPLEMENTED ON A SMALL PROGRAMMABLE CALCULATOR

D. D. VICROY 1984 58 p refs

(NASA-TM-86275; NAS 1.15:86275) Avail: NTIS HC A04/MF A01 CSCL 01D

A simplified flight management descent algorithm was developed and programmed on a small programmable calculator. It was designed to aid the pilot in planning and executing a fuel conservative descent to arrive at a metering fix at a time designated by the air traffic control system. The algorithm may also be used for planning fuel conservative descents when time is not a consideration. The descent path was calculated for a constant Mach/airspeed schedule from linear approximations of airplane performance with considerations given for gross weight, wind, and nonstandard temperature effects. An explanation and examples of how the algorithm is used, as well as a detailed flow chart and listing of the algorithm are contained.

Author

N84-29872# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

HORIZONTAL DIPLOPIA THRESHOLDS FOR HEAD-UP DISPLAYS Final Report

R. WARREN, L. V. GENCO, and T. R. CONNOR Apr. 1984 47 p

(AD-A141965; AFAMRL-TR-84-018) Avail: NTIS HC A03/MF A01 CSCL 06P

Horizontal diplopia thresholds were determined using a Head-Up Display (HUD) emulator which superimposed a small vertical line at various degrees of binocular disparity on a rich outdoor scene. The main findings are that observers are more intolerant of negative disparity than positive disparity. In negative disparity, a non-fixated object is optically further than a fixated object. For 32 observers, the overall median negative disparity threshold was 1.2 mrad and the overall median positive disparity threshold was 2.6 mrad. Assuming that pilots fixate on external targets, these results suggest that HUD imagery should be placed at a slightly nearer optical distance than background targets. The results also indicate that: (1) longer viewing is more likely to lead to a diplopia effect than short glances, (2) resistance to diplopia appears to be an individual trait, and (3) a large proportion of responses involve suppression of the image in one eye. The report also includes a table of the percentage of observers reporting diplopia as a function of disparity magnitude. This table may be used to predict the incidence rate

of diplopia among pilots for any allowed degree of disparity.

Author (GRA)

N84-29873# Institute for Defense Analyses, Alexandria, Va. Science and Technology Div.

F-15 AN/APG-63 RADAR CASE STUDY REPORT IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY) STUDY Final Report, Jul. 1982 - Aug. 1983
P. F. GOREE Aug. 1983 315 p
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This document records the activities and presents the findings of the F-15 AN/APG-63 Radar Case Study Working Group, part of the IDA/OSD Reliability and Maintainability Study, conducted during the period from July 1982 through August 1983. GRA

N84-29874# Institute for Defense Analyses, Alexandria, Va.
F-16 APG-66 FIRE CONTROL RADAR CASE STUDY REPORT IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY) STUDY Final Report, Jul. 1982 - Aug. 1983

P. F. GOREE Aug. 1983 252 p
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NTIS HC A12/MF A01 CSCL 19E

This document records the activities and presents the findings of the F-16 APG-66 Fire Control Radar Case Study Working Group, part of the IDA/OSD Reliability and Maintainability Study, conducted during the period from July 1982 through August 1983. GRA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A84-40140

FLIGHT TESTING OF AIRPLANE AND HELICOPTER GAS TURBINE ENGINES [LETNYE ISPYTANIA GAZOTURBINNYKH DVIGATELEI SAMOLETOV I VERTOLETOV]

G. P. DOLGOLENKO, ED. Moscow, Izdatel'stvo Mashinostroenie, 1983, 112 p. In Russian.

The principal types, objectives, and schedules of flight tests conducted on gas turbine engines during various stages on their development and during the service of airplanes and helicopters are reviewed. Test procedures and the equipment used are discussed in detail, with attention given to flying laboratories, special instrumentation, and computer-controlled ground and airborne systems for collecting, processing, and analyzing flight test data. Methods for the in-flight evaluation of the performance and process parameters of gas turbine engines, gas turbine engines, both under steady and transient conditions, as well as their gas dynamic stability and the loading of structural elements are examined. No individual items are abstracted in this volume V.L.

A84-40239*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF A HIGH-WORK LOW ASPECT RATIO TURBINE TESTED WITH A REALISTIC INLET RADIAL TEMPERATURE PROFILE

R. G. STABE, W. J. WHITNEY, and T. P. MOFFITT (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 25 p. refs
(AIAA PAPER 84-1161)

Experimental results are presented for a 0.767 scale model of the first stage of a two-stage turbine designed for a high by-pass ratio engine. The turbine was tested with both uniform inlet conditions and with an inlet radial temperature profile simulating engine conditions. The inlet temperature profile was essentially mixed-out in the rotor. There was also substantial underturning of the exit flow at the mean diameter. Both of these effects were attributed to strong secondary flows in the rotor blading. There were no significant differences in the stage performance with either inlet condition when differences in tip clearance were considered. Performance was very close to design intent in both cases. Previously announced in STAR as N84-24589 Author

A84-40244*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN OVERVIEW OF NASA INTERMITTENT COMBUSTION ENGINE RESEARCH

E. A. WILLIS and W. T. WINTUCKY (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 34 p. refs
(AIAA PAPER 84-1393)

This paper overviews the current program, whose objective is to establish the generic technology base for advanced aircraft I.C. engines of the early 1990's and beyond. The major emphasis of this paper is on development of the past two years. Past studies and ongoing confirmatory experimental efforts are reviewed, which show unexpectedly high potential when modern aerospace technologies are applied to inherently compact and balanced I.C. engine configurations. Currently, the program is focussed on two engine concepts, the stratified-charge, multi-fuel rotary and the lightweight two-stroke diesel. A review is given of contracted and planned high performance one-rotor and one-cylinder test engine work addressing several levels of technology. Also reviewed are basic supporting efforts, e.g., the development and experimental validation of computerized airflow and combustion process models, being performed in-house at Lewis Research Center and by university grants. Previously announced in STAR as N84-24583

Author

A84-40245*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TANDEM FAN APPLICATIONS IN ADVANCED STOVL FIGHTER CONFIGURATIONS

C. L. ZOLA (NASA, Lewis Research Center, Cleveland, OH), S. B. WILSON, III, and M. A. ESKEY (NASA, Ames Research Center, Moffett Field, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 20 p. refs
(AIAA PAPER 84-1402)

The series/parallel tandem fan engine is evaluated for application in advanced STOVL supersonic fighter aircraft. Options in engine cycle parameters and design of the front fan flow diverter are examined for their effects on engine weight, dimensions, and other factors in integration of the engine with the aircraft. Operation of the engine in high-bypass flow mode during cruise and loiter flight is considered as a means of minimizing fuel consumption. Engine thrust augmentation by burning in the front fan exhaust is discussed. Achievement of very short takeoff with vectored thrust is briefly reviewed for tandem fan engine configurations with vectorable front fan nozzles. Examples are given of two aircraft configuration planforms, a delta-canard, and a forward-swept wing, to illustrate the major features, design considerations, and potential performance of the tandem fan installation in each. Full realization of the advantages of tandem fan propulsion are found to depend

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on careful selection of the aircraft configuration, since integration requirements can strongly influence the engine performance. Previously announced in STAR as N84-24579 Author

A84-40246*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUPERSONIC STOVL EJECTOR AIRCRAFT FROM A PROPULSION POINT OF VIEW

R. LUIDENS, R. PLENCNER, W. HALLER, and A. GLASSMAN (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 18 p. refs (AIAA PAPER 84-1401)

A baseline supersonic STOVL ejector aircraft, its propulsion and typical operating modes is described, and important propulsion parameters are identified. Then a number of propulsion system changes are evaluated for improvement of the lift-off performance aft deflection of the ejector jet and heating of the ejector primary air either by burning or using the hot engine core flow. The possibility for cooling the footprint is illustrated for mixing or interchanging the fan and core flows, and in use of a core flow ejector. The application of a new engine concept the turbine bypass engine plus a turbocompressor to supply the ejector primary air, and thrust during takeoff combat are presented. Previously announced in STAR as N84-24581 E.A.K.

A84-40247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUPERSONIC STOVL AIRCRAFT WITH TURBINE BYPASS/TURBO-COMPRESSOR ENGINES

L. C. FRANCISCUS and R. W. LUIDENS (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 15 p. refs (AIAA PAPER 84-1403)

Three propulsion systems for a Mach 2 STOVL fighter were compared. The three propulsion systems are: (1) turbine bypass engine with a turbocompressor used for STOVL only; (2) turbine bypass engine with a turbocompressor for both STOVL and thrust during forward flight; and (3) mixed flow afterburning turbofan with a remote burner lift system. In the first system, the main engines have afterburners and the turbocompressors use afterburning during STOVL. In the second system, the turbine bypass engines are dry and the turbocompressors have afterburners. The mission used in the study is a deck launched intercept mission. It is indicated that large improvements in combat time are possible when the turbocompressors are used for both left and thrust for forward flight. Previously announced in STAR as N84-24582 E.A.K.

A84-40786

ROTORCRAFT PROPULSION - AN OVERVIEW

D. WOODLEY (Boeing Vertol Co., Philadelphia, PA) Vertiflite (ISSN 0042-4455), vol. 30, July-Aug. 1984, p. 18-22.

Rotorcraft progress is asserted to have depended on the available powerplant, and will continue to do so. Gas turbines replaced piston drives in the 1950s by providing more thrust per pound and less vibration, thereby allowing construction of larger and faster machines. Fuel consumption increased and only recently was reduced to levels of 30 yr ago. Further refinements are necessary for higher fuel efficiencies and better responsiveness, as well as enhanced reliability. New configurations such as the X-wing and tilt-rotor are under development. The engines will be redesigned with higher compression ratios, centrifugal compressors and advanced cooling methods. Convertible engines will be tested to deliver high shaft power at low thrust and high propulsive efficiency at low shaft power. The convertible engines may have variable pitch blades and stators and bleed compressors. A compound diesel may replace the gas turbine. M.S.K.

A84-40787* General Electric Co., Lynn, Mass.

POWERPLANT DESIGN FOR ONE-ENGINE-INOPERATIVE OPERATION

R. HIRSCHKRON, E. MARTIN (General Electric Co., Lynn, MA), and N. SAMANICH (NASA, Lewis Research Center, Cleveland, OH) Vertiflite (ISSN 0042-4455), vol. 30, July-Aug. 1984, p. 34-38.

Regulatory changes are proposed for new engine certification for multi-engine helicopters to account for contingency operations when one engine goes out at take-off. The new rules are needed because current regulations define category A and B conditions as one-engine out, land immediately, or continue take-off, respectively. Category A is seldom feasible while Category B requires oversize engines, implying lowered fuel efficiencies. However, NASA studies have shown that engines with large contingency power can operate more efficiently in normal conditions due to decreased coolant flow. Techniques for realizing up to a 50 percent power augmentation with minor modifications of existing engines are described. M.S.K.

A84-40789

COMPONENT RESEARCH FOR HELICOPTER ENGINES OF THE 21ST CENTURY

K. C. CIVINSKAS and C. L. WALKER (U.S. Army, Propulsion Laboratory, Cleveland, OH) Vertiflite (ISSN 0042-4455), vol. 30, July-Aug. 1984, p. 46-50.

The directions and tools, both analytical and experimental, being brought to bear on helicopter engine development are explored. Increased computer power and speed permits three-dimensional modeling of complex flowfields and blade performance, which can be verified with laser anemometry. Axial and radial inflow geometries are being investigated, as are ceramic shells, contoured stator end walls and tailored radial flow turbine, an annular combustor with a felt/ceramic composite liner, high temperature bearing and gear steel, and variable capacity regenerative and turbocompound engines. The turbocompound engine would couple the shaft output of a turbine with the high combustion pressure and high crankshaft speeds of the diesel. M.S.K.

A84-40790

ARMY AVIATION DEMONSTRATOR ENGINE PROGRAM [D]

R. FURGURSON (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) Vertiflite (ISSN 0042-4455), vol. 30, July-Aug. 1984, p. 52-54.

Program segments and results of the Army Demonstrator Engine project for upgrading the gas turbine engine data base are outlined. Tests were run with existing engines to examine the effects of addition of a heat exchanger. The program was then focused on development of a 1500 shp engine and a small turbine advanced gas generator. An inlet particle separator, a suction fuel system and reliability, maintainability, safety and survivability were all examined for the 1500 shp unit. Increased horsepower was obtained by scaling the flow path parts, reducing the pressure ratio and fine-tuning the engine. An advanced demonstrator engine was produced and provides a technical base for upgrading engines in the 800 shp class. M.S.K.

A84-40792

HOW WELL DO COMPOSITE PROPELLERS WEATHER?

Aerospace Engineering (ISSN 0736-2536), vol. 4, July-August 1984, p. 47-51.

In 1973, carbon fiber-reinforced composite propeller blades were constructed, and subsequently installed in the propulsion systems of a hovercraft vehicle where they were subjected to sea water spray, exhaust gases, and particulate matter suspensions. Test pieces cut from the hovercraft's propeller blades after 10 years of service have been subjected to static and dynamic tests to determine the degree of environmentally induced deterioration. Comparisons were made with environmental test control samples, and the results obtained were noted to be in good agreement. O.C.

A84-40833#

VANE STAGGER ANGLE AND CAMBER EFFECTS IN FAN NOISE GENERATION

J. B. H. M. SCHULTEN (National Lucht - en Ruimtevaartlaboratorium, Amsterdam, Netherlands) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1071-1079. Research sponsored by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart. refs

Previously cited in issue 10, p. 1377, Accession no. A83-25956

A84-41225

BIG CHANGES IN THE AIRLINER ENGINE WORLD - BALANCING RELIABILITY, MAINTAINABILITY AND COST

P. CONDOM Interavia (ISSN 0020-5168), vol. 39, July 1984, p. 687-689.

Commercial aircraft engines presently achieve over-water reliability rates an order of magnitude better than required. Fixed overhaul schedules have been replaced by new monitoring and inspection techniques, thereby reducing maintenance time and costs. The airlines may, however, require minimum maintenance while engine manufacturers desire optimum performance. Warranties are therefore only given on spare parts. Manufacturers are producing engines with fewer parts and high performance. High performance was gained with air-cooled blades that are more expensive to maintain. The parts last longer, though, and the trend toward dual-rather than four-engine aircraft is a harbinger that engine and part sales will decline and so will the number of engine manufacturers.

M.S.K.

A84-41245

TURBOPROP ENGINES FOR THE FUTURE

J. F. COPLIN (Rolls-Royce, Ltd., London, England) Exxon Air World, vol. 35, no. 3, 1983, p. 10-13.

Possible engine evolutions to produce higher fuel efficiencies for commuter and medium range passenger aircraft are discussed. It is noted that over 7000 Dart engines were sold by 1982. The upgraded Dart, the Mk551, increases fuel efficiency by 10 percent with a few advances in the compressions system. A 10,000-15,000 shp turboprop is under development for 90-100 seat commuter aircraft. A propfan configuration is the leading candidate for new 150 seat aircraft and would offer 80 percent propeller efficiencies at Mach 0.8 cruise speeds. The potential for using contra-rotation to reduce the propfan gearbox size is discussed, together with needed noise and vibration reduction techniques if the propfan is to be accepted.

M.S.K.

A84-41641#

TURBOFAN MIXER NOZZLE FLOW FIELD - A BENCHMARK EXPERIMENTAL STUDY

R. W. PATERSON (United Technologies Research Center, East Hartford, CT) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 692-698. refs

An experimental investigation of the three-dimensional flow field within a multilobed model turbofan forced-mixer nozzle was conducted. The objective of the study was to provide detailed velocity and thermodynamic state variable data for use in assessing the accuracy and assisting the further development of computational procedures for predicting the flow field within mixer nozzles. Velocity and temperature data suggested that the nozzle mixing process was dominated by large-scale secondary circulations that were associated with strong radial velocities observed near the lobe exit plane. Flow field similarity for variable inlet temperature conditions was also observed, although unanticipated.

Author

A84-41642#

A NEW GENERATION OF ALLISON MODEL 250 ENGINES

J. A. BYRD (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 106, July 1984, p. 703-711.

(ASME PAPER 84-GT-197)

Allison is actively developing two new additions to the Model 250 product line, the C34 and C24 engines, targeted for mid-1980s production. The C34 engine is a growth version of the Model 250-C30 and will provide a 10 percent power increase throughout the flight envelope. The C24 engine features decreased fuel consumption, one-engine-inoperative (OEI) ratings, and substantial increases in hot day performance compared to its predecessor, the highly successful C20B. Both engines incorporate single-stage turbines, digital electronic control units, and new shafting arrangements and are designed for increased reliability and durability, reduced complexity and part count, less maintenance, and decreased operating costs.

Author

A84-41783#

INVESTIGATION ON INTEGRATED SELECTION OF OPTIMUM ENGINE CYCLE PARAMETERS

J. ZHANG, D. CHEN, X. ZHU, and Z. ZHU (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, March 1984, p. 51-60. In Chinese, with abstract in English. refs

A method for integrating the selection of optimal aircraft engine cycle parameters is proposed from the viewpoint of system engineering, and a control scheme is proposed which takes into account matching and interaction between the engine and the aircraft. A rapid method for predicting turbojet or turbofan engine off-design performance is adopted and an empirical formula for estimating the engine weight is developed. An augmented engine scheme that meets modification requirements is presented as an example. The results show that the optimum cycle parameters and the control scheme are quite different if the mission, modification requirements, or technical constraints are varied.

C.D.

A84-42378* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A PIECEWISE LINEAR STATE VARIABLE TECHNIQUE FOR REAL TIME PROPULSION SYSTEM SIMULATION

J. R. MIHALOEWS (NASA, Lewis Research Center, Cleveland, OH) and S. P. ROTH (United Technologies Corp., Government Products Div., West Palm Beach, FL) IN: Annual Pittsburgh Conference, 13th, Pittsburgh, PA, April 22, 23, 1982, Proceedings. Part 1. Research Triangle Park, NC, Instrument Society of America, 1982, p. 1-12. Previously announced in STAR as N82-24201.

The emphasis on increased aircraft and propulsion control system integration and piloted simulation has created a need for higher fidelity real time dynamic propulsion models. A real time propulsion system modeling technique which satisfies this need and which provides the capabilities needed to evaluate propulsion system performance and aircraft system interaction on manned flight simulators was developed and demonstrated using flight simulator facilities at NASA Ames. A piecewise linear state variable technique is used. This technique provides the system accuracy, stability and transient response required for integrated aircraft and propulsion control system studies. The real time dynamic model includes the detail and flexibility required for the evaluation of critical control parameters and propulsion component limits over a limited flight envelope. The model contains approximately 7.0 K bytes of in-line computational code and 14.7 K of block data. It has an 8.9 ms cycle time on a Xerox Sigma 9 computer. A Pegasus-Harrier propulsion system was used as a baseline for developing the mathematical modeling and simulation technique. A hydromechanical and water injection control system was also simulated. The model was programmed for interfacing with a Harrier aircraft simulation at NASA Ames. Descriptions of the real time methodology and model capabilities are presented.

Author

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A84-42382* Notre Dame Univ., Ind.

AN APPLICATION OF TENSOR IDEAS TO NONLINEAR MODELING OF A TURBOFAN JET ENGINE

T. A. KLINGLER, S. YURKOVICH, and M. K. SAIN (Notre Dame, University, Notre Dame, IN) IN: Annual Pittsburgh Conference, 13th, Pittsburgh, PA, April 22, 23, 1982, Proceedings. Part 1. Research Triangle Park, NC, Instrument Society of America, 1982, p. 45-54. refs
(Contract NSG-3048)

An application of tensor modelling to a digital simulation of NASA's Quiet, Clean, Shorthaul Experimental (QCSE) gas turbine engine is presented. The results show that the tensor algebra offers a universal parametrization which is helpful in conceptualization and identification for plant modelling prior to feedback or for representing scheduled controllers over an operating line. C.D.

A84-42416#

FREQUENCIES AND MODE SHAPES OF ROTATING BLADED AXISYMMETRIC STRUCTURES - APPLICATION TO A JET ENGINE

G. FERRARIS, R. HENRY, M. LALANNE, and P. TROMPETTE (Lyon, Institut National des Sciences Appliquees, Villeurbanne, Rhone, France) IN: Vibrations of bladed disk assemblies; Proceedings of the Ninth Biennial Conference on Mechanical Vibration and Noise, Dearborn, MI, September 11-14, 1983. New York, American Society of Mechanical Engineers, 1983, p. 1-10. Research supported by SNECMA. refs

This paper deals with the prediction of the dynamic behavior of bladed axisymmetric systems. The structure consists of axisymmetric components having thin and thick parts and a high number of twisted blades. The thin parts are modeled with thin shell axisymmetric elements, the thick parts with thick isoparametric elements and the blades with twisted beam elements, including predominant effects such as bending-bending and bending-torsion coupling. Junction elements are used to insure slope and displacement continuity between the various finite elements having three, four and six degrees of freedom per node. Kinetic and strain energies, including the rotating effects are calculated and governing equations are derived using Lagrange's equations. The developed method and the associated computer program is applied to the determination of frequencies and mode shapes of a rotating low pressure stage of a recent jet engine. Author

A84-42417#

FREE AND FORCED VIBRATION OF TURBINE BLADES

J. S. RAO (Indian Institute of Technology, New Delhi, India) and H. M. JADVANI (Regional Engineering College, Surat, India) IN: Vibrations of bladed disk assemblies; Proceedings of the Ninth Biennial Conference on Mechanical Vibration and Noise, Dearborn, MI, September 11-14, 1983. New York, American Society of Mechanical Engineers, 1983, p. 11-24. Research supported by the Aeronautical Research and Development Board. refs

The kinetic and strain energy expressions for a tapered twisted aerofoil cross-section blade mounted at a stagger angle on a rotating disk are obtained using beam theory neglecting higher order effects such as shear deformation, rotary inertia, Coriolis forces. Equations of Lagrange are used to derive equations of motion and set up the eigenvalue problem to obtain the coupled bending-bending-torsion mode frequencies. Assuming proportional viscous damping the expression for energy dissipated in the rotating blade is derived. The virtual work due to nozzle passing excitation is also set up and the equations of motion for forced vibrations of a blade are derived. These equations are solved by modal analysis. A general computer program is developed to determine the response of the blade and the results obtained are discussed. Author

A84-42420#

A STUDY OF UNSTEADY PRESSURES NEAR THE TIP OF A TRANSONIC FAN IN UNSTALLED SUPERSONIC FLUTTER

D. G. HALLIWELL, S. G. NEWTON, and K. S. LIT (Rolls-Royce, Ltd., Derby, England) IN: Vibrations of bladed disk assemblies; Proceedings of the Ninth Biennial Conference on Mechanical Vibration and Noise, Dearborn, MI, September 11-14, 1983. New York, American Society of Mechanical Engineers, 1983, p. 91-96. Research supported by Rolls-Royce, Ltd., and Ministry of Defence of England. refs

A comparison of experimental and theoretical results is presented for a modern transonic research fan, vibrating in a coupled flutter mode. The measurement of steady and unsteady pressures on the aerofoil surface is described, as also is the derivation of the accompanying blade motion using casing-mounted frequency modulated grids. This complex motion is made use of to calculate unsteady pressures from various unsteady aerodynamic theories. These theoretical models are reviewed in turn and compared against the experimental data at a reference blade section. Considering the complexity of the flow and the inherent simplifying assumptions, the comparisons on both amplitude and phase are generally favourable. The position of the shock in the blade passage is shown to be important. The comparison is extended to unsteady work and again the results are favorable if allowance is made for the differences in blade pressure ratio between the various theories and the experiment. Author

A84-42421#

TWIN MODE ANALYSIS OF AEROENGINE FAN VIBRATION AND FLUTTER FOR USE IN DESIGN STUDIES

R. A. J. FORD (New South Wales, University, Sydney, Australia) and A. V. SRINIVASAN (United Technologies Research Center, East Hartford, CT) IN: Vibrations of bladed disk assemblies; Proceedings of the Ninth Biennial Conference on Mechanical Vibration and Noise, Dearborn, MI, September 11-14, 1983. New York, American Society of Mechanical Engineers, 1983, p. 97-104. refs

An analysis of fan vibration is presented which incorporates the effects of mistuning (blade to blade vibration) by using the concept of twin orthogonal modes. It extends earlier conceptual studies of this form to provide a comprehensive analysis suitable for use in design studies and interpreting test results. The analysis covers forced response (standing or traveling wave) as well as flutter. Results are presented for a typical rotor and for the tuned case the results are consistent with an earlier published flutter analysis. The effect of detuning this rotor is also studied. Author

A84-42707#

CT7 1700 HORSEPOWER ENGINE

J. D. STEWART (General Electric Co., Aircraft Engine Business Group, Lynn, MA) American Institute of Aeronautics and Astronautics and NASA, General Aviation Technology Conference, Hampton, VA, July 10-12, 1984. 11 p.
(AIAA PAPER 84-2229)

The General Electric CT7 Turboprop engine is a 1700 SHP class engine designed and developed to meet the requirements of the Commuter Airline Market. The CT7 Turboprop engine was developed from the highly successful T700/CT7 family of Military and Commercial Turboshaft engines currently in production. This paper discusses the design and development of the Turboprop engine through the use of Advanced Technology to achieve improved performance and low specific fuel consumption. Included are descriptions of the component redesign of the Compressor, High Pressure Turbine Power Turbine and Inlet System. Also discussed are the Propeller Gearbox and Engine Control System designs, current programs being conducted to further enhance engine performance and specific fuel consumption, and the CT7 Flight Test and Certification Programs. Author

N84-28788*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

ENERGY EFFICIENT ENGINE HIGH-PRESSURE TURBINE DETAILED DESIGN REPORT

R. D. THULIN, D. C. HOWE, and I. D. SINGER Jan. 1982 164 p refs

(Contract NAS3-20646)

(NASA-CR-165608; NAS 1.26:165608; PWA-5594-171) Avail:

NTIS HC A08/MF A01 CSCL 21E

The energy efficient engine high-pressure turbine is a single stage system based on technology advancements in the areas of aerodynamics, structures and materials to achieve high performance, low operating economics and durability commensurate with commercial service requirements. Low loss performance features combined with a low through-flow velocity approach results in a predicted efficiency of 88.8 for a flight propulsion system. Turbine airfoil durability goals are achieved through the use of advanced high-strength and high-temperature capability single crystal materials and effective cooling management. Overall, this design reflects a considerable extension in turbine technology that is applicable to future, energy efficient gas-turbine engines. Author

N84-28789*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.

ENERGY EFFICIENT ENGINE: TURBINE INTERMEDIATE CASE AND LOW-PRESSURE TURBINE COMPONENT TEST HARDWARE DETAILED DESIGN REPORT

K. LEACH, R. D. THULIN, and D. C. HOWE Jan. 1982 288 p refs

(Contract NAS3-20646)

(NASA-CR-167973; NAS 1.26:167973; PWA-5594-191) Avail:

NTIS HC A13/MF A01 CSCL 21E

A four stage, low pressure turbine component has been designed to power the fan and low pressure compressor system in the Energy Efficient Engine. Designs for a turbine intermediate case and an exit guide vane assembly also have been established. The components incorporate numerous technology features to enhance efficiency, durability, and performance retention. These designs reflect a positive step towards improving engine fuel efficiency on a component level. The aerodynamic and thermal/mechanical designs of the intermediate case and low pressure turbine components are presented and described. An overview of the predicted performance of the various component designs is given. R.S.F.

N84-28790*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VELOCITY AND TEMPERATURE CHARACTERISTICS OF TWO-STREAM, COPLANAR JET EXHAUST PLUMES

U. H. VONGLAHN, J. GOODYKOONTZ, and C. WASSERBAUER 1984 39 p refs Presented at the 2nd Appl. Aerodyn. Conf., Seattle, 21-23 Aug. 1984; sponsored by AIAA

(NASA-TM-83730; E-2205; NAS 1.15:83730; AIAA-84-2205)

Avail: NTIS HC A03/MF A01 CSCL 21E

The subsonic jet exhaust velocity and temperature characteristics of model scale, two stream coplanar nozzles were obtained experimentally. The data obtained included the effects of fan to primary stream velocity and temperature ratios on the jet axial and radial flow characteristics. Empirical parameters were developed to correlate the measured data. The resultant equations were shown to be extensions of a previously published single stream jet velocity and temperature correlation. Author

N84-28791*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN OVERVIEW OF THE NASA ROTARY ENGINE RESEARCH PROGRAM

P. R. MENG and W. F. HADY 1984 26 p refs Presented at the West Coast Intern. Meeting, San Diego, Calif., 6-9 Aug. 1984; sponsored by SAE

(NASA-TM-83699; E-2157; NAS 1.15:83699) Avail: NTIS HC

A03/MF A01 CSCL 21E

A brief overview and technical highlights of the research efforts and studies on rotary engines over the last several years at the NASA Lewis Research Center are presented. The test results obtained from turbocharged rotary engines and preliminary results from a high performance single rotor engine were discussed. Combustion modeling studies of the rotary engine and the use of a Laser Doppler Velocimeter to confirm the studies were examined. An in-house program in which a turbocharged rotary engine was installed in a Cessna Skymaster for ground test studies was reviewed. Details are presented on single rotor stratified charge rotary engine research efforts, both in-house and on contract. Author

N84-28792*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

PRELIMINARY FLIGHT EVALUATION OF F100 ENGINE MODEL DERIVATIVE AIRSTART CAPABILITY IN AN F-15 AIRPLANE

T. K. CHO and F. W. BURCHAM, JR. Jul. 1984 31 p refs Prepared in cooperation with NASA. Ames Research Center

(NASA-TM-86031; H-1200; NAS 1.15:86031) Avail: NTIS HC

A03/MF A01 CSCL 21E

A series of airtarts was conducted in an F-15 airplane with two prototype F100 engine model derivative (EMD) engines equipped with digital electronic engine control (DEEC) systems. The airtart envelope and time required for airtarts were defined. The success of an airtart is most heavily dependent on airspeed. Spooldown airtarts at 200 knots and higher were all successful. Spooldown airtart times ranged from 53 sec at 250 knots to 170 sec at 175 knots. Jet fuel starter (JFS) assisted airtarts were conducted at 175 knots at two altitudes, and airtart times were 50 and 60 sec, significantly faster than unassisted airtart. The effect of altitude on airtarts was small. In addition, the airtart characteristics of the two test engines were found to closely resemble each other. The F100 EMD airtart characteristics were very similar to the DEEC equipped F100 engine tested previously. Finally, the time required to spool down from intermediate power compressor rotor speed to a given compressor rotor speed was found to be a strong function of altitude and a weaker function of airspeed. Author

N84-28793*# National Aeronautics and Space Administration, Washington, D. C.

GROWIAN ROTOR BLADES: PRODUCTION DEVELOPMENT, CONSTRUCTION AND TEST

H. M. THIELE Jul. 1984 80 p refs Transl. into ENGLISH of "Growian Rotorblätter: Fertigungsentwicklung, Bau und Test" rept. BMFT-FB-T-83-111 BMFT, Bonn, Jun. 1983 p 1-76 Original language was announced as N84-11526 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASW-3542)

(NASA-TM-77479; NAS 1.15:77479; BMFT-FB-T-83-111) Avail:

NTIS HC A05/MF A01 CSCL 21E

Development and construction of three 50 m rotor blades for a 3 MW wind turbine are described. A hybrid concept was chosen, i.e., a load carrying inflexible steel spar and a glass fiber reinforced plastic skin. A test blade was constructed and static loading tests, dynamic vibration tests and fatigue tests on critical welds as well as at the connection between spar and blade skin were performed. All test results show good accordance with calculated values, and were taken into consideration during the construction of two rotor blades. Author (IAA)

07 AIRCRAFT PROPULSION AND POWER

N84-28794*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mechanical and Aerospace Engineering.
DILUTION JETS IN ACCELERATED CROSS FLOWS Ph.D. Thesis Final Report

A. LIPSHITZ and I. GREBER Jun. 1984 315 p refs
(Contract NSG-3206)
(NASA-CR-174717; NAS 1.26:174717) Avail: NTIS HC A14/MF A01 CSCL 21E

Results of flow visualization experiments and measurements of the temperature field produced by a single jet and a row of dilution jets issued into a reverse flow combustor are presented. The flow in such combustors is typified by transverse and longitudinal acceleration during the passage through its bending section. The flow visualization experiments are designed to examine the separate effects of longitudinal and transverse acceleration on the jet trajectory and spreading rate. A model describing a dense single jet in a lighter accelerating cross flow is developed. The model is based on integral conservation equations, including the pressure terms appropriate to accelerating flows. It uses a modified entrainment correlation obtained from previous experiments of a jet in a cross stream. The flow visualization results are compared with the model calculations in terms of trajectories and spreading rates. Each experiment is typified by a set of three parameters: momentum ratio, density ratio and the densimetric Froude number. M.A.C.

N84-28795*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DETAILED FLOW MEASUREMENTS IN CASING BOUNDARY LAYER OF 429-METER-PER-SECOND-TIP-SPEED TWO-STAGE FAN

W. T. GORRELL Jan. 1984 33 p refs Prepared in cooperation with Army Aviation Research and Development Command, Cleveland
(NASA-TP-2052; E-219; NAS 1.60:2052; AVRADCOM-TR-81-C-28) Avail: NTIS HC A03/MF A01 CSCL 21E

Detailed flow measurements between all blade rows were taken in the outer 30 percent of passage height of a two stage fan. Tabulations of the detailed flow measurements are included. Results of these measurements revealed the steep axial velocity profiles near the casing. The axial velocity profile near the casing at the rotor exists was much steeper than at the stator exits. The data also show overturning of the flow at the tip at the stator exits. The effect of mixing is shown by the redistribution of the first stage rotor exit total temperature profile as it passes through the following stator. Author

N84-28796# TRW Space Technology Labs., Redondo Beach, Calif. Engineering Sciences Lab.

WALL EFFECTS ON COMBUSTION IN AN ENGINE Final Report, 15 Mar. 1983 - 14 May 1984

F. E. FENDELL 14 May 1984 9 p
(Contract DAAG29-83-C-0010)
(AD-A141418; TRW-S/N-41354.000; ARO-19972.4-EG) Avail: NTIS HC A02/MF A01 CSCL 21G

This project utilized theoretical modeling and laboratory experiment to elucidate the role of chamber shaping on the combustion event in a four-stroke-cycle, reciprocating-piston-type internal-combustion-engine cylinder. First, theoretical modeling was carried out to evaluate heat transfer as a determinant of end-gas knock during nonisobaric flame propagation across a homogeneous charge in a variable-volume enclosure. Via a semi-empirical model, turbulent combustion in an automotive cylinder was considered; a three-zone generalization (to encompass end gas, unburned bulk gas and burned gas) of the standard two-zone Otto-cycle-combustion model was developed. Via a self-contained model, laminar combustion in a specially designed rapid-compression machine was considered; an asymptotic analysis valid in the limit of large Arrhenius activation temperature was developed. For given operating conditions, the fraction of the charge (if any) that undergoes autoconversion to product prior to flame arrival can be ascertained, along with the heat transfer

sufficient to preclude such homogeneous explosion. Second, two-wall, or crevice-type, quenching of flame propagation through a stoichiometric or fuel-lean hydrocarbon-air-type premixture is examined because this phenomenon is now believed to be the major source of unburned-hydrocarbon emissions from homogeneous-charge engines. GRA

N84-28797# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

STATOR BLADE ROW GEOMETRY MODIFICATION INFLUENCE ON TWO-STAGE, AXIAL-FLOW COMPRESSOR AERODYNAMIC PERFORMANCE Technical Report, 1 Oct. 1978 - 30 Apr. 1983

D. L. TWEEDT and T. H. OKIISHI Air Force Office of Scientific Res., Wash., D.C. Dec. 1983 260 p
(Contract F49620-83-K-0023; AF PROJ. 2307)
(AD-A141793; ISU-ERI-AMES-84179; TCRL-25; AFOSR-84-0418TR) Avail: NTIS HC A12/MF A01 CSCL 21E

The influence of stator row geometry modification on the aerodynamic performance of a two-stage, low-speed, axial-flow research compressor was assessed in the experiments described in this project. Stator geometry modifications tested included stator leading edge forward symmetrical sweep, large-radius blade/annulus wall corner fillets, and stator hub gap sealing (shrouding). Comparisons were made between detailed aerodynamic data associated with baseline and modified configurations. Substantial stator exit flow-field changes attributable to symmetrical sweeping of stator leading edges and to hub clearance sealing were observed with some evidence of corresponding near end wall loss reduction. The effects of large radii filleting were less clear. Interesting conclusions about the off-design flow rate performance of the compressor also resulted from consideration of experimental data. Author (GRA)

N84-28798# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

AERODYNAMIC DESIGN AND PERFORMANCE OF A TWO-STAGE, AXIAL-FLOW COMPRESSOR (BASELINE) Technical Report, 1 Oct. 1978 - 30 Nov. 1982

M. D. HATHAWAY and T. H. OKIISHI Dec. 1983 204 p
(Contract F49620-83-K-0023; AF PROJ. 2307)
(AD-A141796; ISU-ERI-AMES-84178; TCRL-24; AFOSR-84-0417TR) Avail: NTIS HC A10/MF A01 CSCL 21E

A two-stage, baseline configuration, low-speed, axial-flow research compressor was designed, built and tested at design flow. The design, fabrication and data acquisition and reduction details are described. Time-averaged, spatially detailed and overall flow and aerodynamic performance data for design flow operation of the compressor are presented and discussed. Author (GRA)

N84-28799# SRI International Corp., Menlo Park, Calif.

BASIC STUDY OF FUEL STORAGE STABILITY Final Report, 15 Jul. 1980 - 31 Mar. 1984

F. R. MAYO May 1984 13 p
(Contract DAAG29-80-C-0122)
(AD-A142194; ARO-17062.5-EG) Avail: NTIS HC A02/MF A01 CSCL 21E

The goal of this program was to determine the chemistry of deposit formation on hot parts of diesel and jet turbine engines and thus to predict and prevent deposit formation. These deposits are assumed to come mostly from soluble gum formed on storage. The fuels used for the study were distilled at low pressure and stored under nitrogen and refrigeration. We measured rates of oxygen absorption from air, $R_{sub O}$ and total gum formation, $r_{sub g}$ at 130 C without initiator and at 100 with added t-Bu202. The gum measured was mostly or wholly soluble in the fuel; insoluble gum, if any, was a minor product. Author (GRA)

N84-28800# Lanchester Polytechnic, Coventry (England). Dept. of Mechanical Engineering.

A DIAGNOSTIC TECHNIQUE FOR IMPROVING COMBUSTOR PERFORMANCE

B. L. BUTTON and P. R. S. WHITE 1982 11 p refs Presented at 2nd Polytech. Symp. on Thermodyn. and Heat Transfer, Leicester, England, Nov. 1982 Sponsored by United Kingdom Ministry of Defence Procurement Executive

Avail: NTIS HC A02/MF A01

A technique for monitoring airflow and fuel distribution within the primary zone of a gas turbine combustor was described. A carbon monoxide tracer gas was injected into the flow to be examined in order to seed the primary air or simulate the fuel flow. The subsequent distribution was obtained using an accurately positioned sampling probe feeding an infra red analyzer. Results were verified by running a combustor under full load conditions.

Author (ESA)

N84-29875*# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.

PURDU-WINCOF: A COMPUTER CODE FOR ESTABLISHING THE PERFORMANCE OF A FAN-COMPRESSOR UNIT WITH WATER INGESTION Final Report

M. LEONARDO, T. TSUCHIYA, and S. N. B. MURTHY Jan. 1982 292 p refs

(Contract NAG3-204)

(NASA-CR-168005; NAS 1.26:168005) Avail: NTIS HC A13/MF A01 CSCL 21E

A model for predicting the performance of a multi-spool axial-flow compressor with a fan during operation with water ingestion was developed incorporating several two-phase fluid flow effects as follows: (1) ingestion of water, (2) droplet interaction with blades and resulting changes in blade characteristics, (3) redistribution of water and water vapor due to centrifugal action, (4) heat and mass transfer processes, and (5) droplet size adjustment due to mass transfer and mechanical stability considerations. A computer program, called the PURDU-WINCOF code, was generated based on the model utilizing a one-dimensional formulation. An illustrative case serves to show the manner in which the code can be utilized and the nature of the results obtained.

Author

N84-29876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ENERGY EFFICIENT ENGINE PROGRAM CONTRIBUTIONS TO AIRCRAFT FUEL CONSERVATION

P. G. BATTERTON 1984 28 p refs Proposed for presentation at the Aviation Fuel Conservation Symp., Washington, D.C., 10-11 Sep. 1984; sponsored by FAA

(NASA-TM-83741; E-2226; NAS 1.15:83741) Avail: NTIS HC A03/MF A01 CSCL 21E

Significant advances in high bypass turbofan technologies that enhance fuel efficiency have been demonstrated in the NASA Energy Efficient Engine Program. This highly successful second propulsion element of the NASA Aircraft Energy Efficiency Program included major contract efforts with both General Electric and Pratt & Whitney. Major results of these efforts will be presented including highlights from the NASA/General Electric E3 research turbofan engine test. Direct application of all the E3 technologies could result in fuel savings of over 18% compared to the CF6-50 and JT9D-7. Application of the E3 technologies to new and derivative engines such as the CF6-80C and PW 2037, as well as others, will be discussed. Significant portions of the fuel savings benefit for these new products can be directly related to the E3 technology program. Finally, results of a study looking at far term advanced turbofan engines will be briefly described. The study shows that substantial additional fuel savings over E3 are possible with additional turbofan technology programs.

Author

N84-29877*# Pennsylvania State Univ., University Park. Mechanical Engineering Building.

A THEORETICAL AND EXPERIMENTAL STUDY OF TURBULENT NONEVAPORATING SPRAYS Final Report

A. S. P. SOLOMON, J. S. SHUEN, Q. F. ZHANG, and G. M. FAETH Jun. 1984 138 p refs

(Contract NAG3-190)

(NASA-CR-174668; NAS 1.26:174668) Avail: NTIS HC A07/MF A01 CSCL 21E

Measurements and analysis limited to the dilute portions of turbulent nonevaporating sprays injected into a still air environment were completed. Mean and fluctuating velocities and Reynolds stress were measured in the continuous phase. Liquid phase measurements included liquid mass fluxes, drop sizes and drop size and velocity correlation. Initial conditions needed for model evaluation were measured at a location as close to the injector exit as possible. The test sprays showed significant effects of slip and turbulent dispersion of the discrete phase. The measurements were used to evaluate three typical models of these processes: (1) a locally homogenous flow (LHF) model, where slip between the phases were neglected; (2) a deterministic separated flow (DSF) model, where slip was considered but effects of drop dispersion by turbulence were ignored; and (3) a stochastic separated flow (SSF) model, where effects of interphase slip and turbulent dispersion were considered using random-walk computations for drop motion. The LHF and DSF models did not provide very satisfactory predictions for the present measurements. In contrast, the SSF model performed reasonably well with no modifications in the prescription of eddy properties from its original calibration. Some effects of drops on turbulence properties were observed near the dense regions of the sprays.

B.W.

N84-29878*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FUEL SAVINGS POTENTIAL OF THE NASA ADVANCED TURBOPROP PROGRAM

J. B. WHITLOW, JR. and G. K. SIEVERS 1984 56 p Presented at the Aviation Fuel Conservation Symp., Washington, D.C., 10-11 Sep. 1984; sponsored by FAA

(NASA-TM-83736; E-2218; NAS 1.15:83736) Avail: NTIS HC A04/MF A01 CSCL 21E

The NASA Advanced Turboprop (ATP) Program is directed at developing new technology for highly loaded, multibladed propellers for use at Mach 0.65 to 0.85 and at altitudes compatible with the air transport system requirements. Advanced turboprop engines offer the potential of 15 to 30 percent savings in aircraft block fuel relative to advanced turbofan engines (50 to 60 percent savings over today's turbofan fleet). The concept, propulsive efficiency gains, block fuel savings and other benefits, and the program objectives through a systems approach are described. Current program status and major accomplishments in both single rotation and counter rotation propeller technology are addressed. The overall program from scale model wind tunnel tests to large scale flight tests on testbed aircraft is discussed.

Author

N84-29879*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECT OF CONTROL LOGIC MODIFICATIONS ON AIRSTART PERFORMANCE OF F100 ENGINE MODEL DERIVATIVE ENGINES IN AN F-15 AIRPLANE Final Report

D. B. CRAWFORD and F. W. BURCHAM, JR. Aug. 1983 30 p refs

(NASA-TM-85900; H-1243; NAS 1.15:85900) Avail: NTIS HC A03/MF A01 CSCL 21E

A series of airstarts were conducted in an F-15 airplane with two prototype Pratt and Whitney F100 Engine Model Derivative engines equipped with Digital Electronic Engine Control (DEEC) systems. The airstart envelope and the time required for airstarts were defined. Comparisons were made between the original airstart logic, and modified logic which was designed to improve the airstart capability. Spool-down airstarts with the modified logic were more successful at lower altitudes than were those with the original logic. Spool-down airstart times ranged from 33 seconds at 250

knots to 83 seconds at 175 knots. The modified logic improved the airstart time from 31% to 53%, with the most improved times at slower airspeeds. Jet fuel starter (JFS)-assisted airstarts were conducted at 7000 m and airstart times were significantly faster than unassisted airstarts. The effect of altitude on airstart times was small. Author

N84-29880# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Thermique Appliquee.
AEROELASTICITY IN TURBOMACHINE-CASCADES Final Scientific Report, 15 Dec. 1982 - 15 Dec. 1983
 A. BOELCS, T. FRANSSON, and P. SUTER 1 Feb. 1984 25 p (Contract AF-AFOSR-0063-83)
 (AD-A141905; EPFL/LTA-TM-3-84) Avail: NTIS HC A02/MF A01 CSCL 21E

The aeroelastician needs reliable efficient methods for calculation of unsteady blade forces in turbomachines. The validity of such theoretical (or empirical) prediction models can only be established if researchers apply their flutter and forced vibration predictions to a number of well documented experimental test cases. Under the present project, a report with nine selected standard configurations for the mutual validity of experimental and theoretical results has been prepared and distributed. Together with the standard configurations, unified nomenclature and reporting formats, to be used in the present work, have been defined. Presently, 'blind tests' predictions are performed at several research institutes, whereafter the experimental and theoretical aeroelastic results will be compiled and analyzed during the third (final) year of the project. The potential for a very positive result from the joint research work has become increasingly larger, as many more institutions than originally previewed are interested in the establishment of the validity of existing and future theoretical models for flutter. As part of the project, two experimental research programs have been initiated in fields where no data could be found in the open literature. Author (GRA)

N84-29881# Failure Analysis Associates, Palo Alto, Calif.
COST/RISK ANALYSIS FOR DISK RETIREMENT, VOLUME 1 Final Report, Feb. 1978 - Jun. 1983
 S. W. HOPKINS, P. M. BESUNER, C. A. RAU, JR., D. W. ALLISON, and J. W. EISCHEN Wright-Patterson AFB, Ohio AFWAL 3 Feb. 1984 265 p
 (Contract F33615-78-C-5005)
 (AD-A141978; FAA-83-4-1-VOL-1; M/T3B-9201-VOL-1; AFWAL-TR-83-4089-VOL-1) Avail: NTIS HC A12/MF A01 CSCL 14A

As the replacement cost for jet engine components increases and the average age of the fleet starts to approach the traditional design life, major life cycle cost savings can potentially be accrued from a Retirement for Cause (RFC) approach to component retirement. This approach takes advantage of the ability of most members of a population (or fleet) of engine components to perform safely for several lifetimes longer than the traditional design life. This report presents details of the development and evaluation of an RFC methodology. GRA

N84-29882# Naval Weapons Center, China Lake, Calif.
ANALYSIS OF PARTICULATES IN THE EXHAUST PLUME OF A TF30 ENGINE AT MILITARY POWER Interim Report, FY83
 L. A. MATHEWS, C. A. HELLER, J. H. JOHNSON, E. D. ERICKSON, and R. T. LODA May 1984 34 p
 (Contract DA PROJ. F65-559)
 (AD-A142510; AD-E900355; NWC-TP-6508) Avail: NTIS HC A03/MF A01 CSCL 21E

This report presents particulate concentration, emission index and size distribution data in the plume of a TF30-P1 engine, run at military power in the open air. The particle size distribution data measured here show that the mass median aerodynamic diameter of the particles is in the range of 0.19-0.30 micrometer compared to an average of 0.18 micrometer for the test cell data for a rebuilt TF30-P414 engine. Recommendations are listed for future tests. GRA

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A84-40574# **INTEGRATING THE FUTURE FIGHTER'S CONTROLS**

C. A. SKIRA (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) Aerospace America (ISSN 0740-722X), vol. 22, July 1984, p. 60-62, 64.

Advanced technology integration and automation to upgrade fighter performance, lower the pilot workload and provide V/STOL capabilities are explored. The Advanced Fighter Technology Integration (AFTI) program has demonstrated that AFTI/F-16s can outperform normal F-16s when control surfaces coordination is handled automatically during maneuvers. Vectored thrust can increase pitch control and eliminate the elevator on aircraft and thrust reversal enhances touchdown accuracy and in-flight propulsion control. A low-bypass-ratio, variable cycle turbofan has been identified for the vectored-thrust fighter. The propulsion system will then be integrated into the airframe and will require a computerized command generator to interface between the pilot and the control surfaces and propulsion subsystems. A mission computer will sense, receive, digest and select only pertinent data for the pilot to view. Many of the concepts are either in the breadboard or wind tunnel trials stages. M.S.K.

A84-40644 **ELECTROSTATIC AUTOPILOTS**

M. L. HILL (Johns Hopkins University, Laurel, MD) Johns Hopkins APL Technical Digest (ISSN 0270-5214), vol. 5, Apr.-June 1984, p. 177-183. refs

Voltage differences as large as several kilovolts can appear between insulated sensors located on the wing tips of an aircraft when it banks in the earth's atmospheric electric field. The sensed differences can be converted into feedback signals to provide a vertical reference for autopilots. Electrostatically stabilized radio-controlled aeromodels and remotely piloted vehicles have been used to investigate the characteristics of electric fields in fair and adverse weather as well as in regions of severe electrical disturbances near thunderstorms. The operational principles of this stabilization method are described here. Author

A84-41072 **TRAJECTORY GENERATION - AN AUTOMATION CONCEPT OF THE FUTURE**

T. E. PERFITT (Lear Siegler, Inc., Grand Rapids, MI), G. L. FILECCIA, and W. L. YOUNG (USAF, Wright Aeronautical Laboratories, Wright-Patterson, OH) IN: Behavioral Objectives in Aviation Automated Systems Symposium; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 25-28, 1982. Warrendale, PA, Society of Automotive Engineers, Inc., 1982, p. 203-209. refs

Some military and commercial applications for electronic trajectory generation systems for aircraft are considered. Airborne mission replanning and pilot decision assistance functions of trajectory generation systems are described. Trajectory generation applied to intrafight and space-time coordination is described in terms of improved combat effectiveness. It is found that significant improvements in aircraft survivability and mission effectiveness can be achieved by using trajectory generation systems. The parallel development of sensors responsive to trajectory generator requirements has significant potential for solving night/all weather navigation problems. Schematic drawings of a trajectory generating system are provided. I.H.

A84-41337#

THE MINIMUM INDUCED DRAG, LONGITUDINAL TRIM AND STATIC LONGITUDINAL STABILITY OF TWO-SURFACE AND THREE-SURFACE AIRPLANES

E. R. KENDALL (Gates Learjet Corp., Wichita, KS) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 11 p. refs (AIAA PAPER 84-2164)

Prandtl and Munk theories are used to demonstrate that a modern three-surface aircraft can be built with minimum drag if equal and opposite vertical loads are applied by the forward and aft trimming surfaces. The aircraft has a wing, an aft-mounted tail and a third surface (canard) mounted ahead of the main wing. It is shown that using both forward and aft surfaces for longitudinal trim induces the minimum drag conditions without regard to the location of the center of gravity. Attention is given to various gap configurations for the three surfaces. The three-surface aircraft is found to have better cruise efficiency in stable trimmed conditions than conventional aft-tail design, which is in turn more efficient in the same situation than a two-surface canard aircraft. Wind tunnel studies are needed to verify the three-surface advantages on actual aircraft equipped with propulsion systems. M.S.K.

A84-41650

ACTIVE EFFECT ON THE AEROELASTICITY OF A LIFTING SURFACE [AKTIVNI OVLIVNOVANI AEROELASTICKYCH VLASTNOSTI NOSNE PLOCHY]

V. DANEK Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 51-55. In Czech. refs

A theoretical study of the active effect on the instability of a simple system (a wing section) with two degrees of freedom is presented. It is shown that the resistance of this system to bending-torsional flutter can be enhanced by using an aerodynamic tab on the trailing edge of the wing. The forced movement of the tab is governed by a law derived from the principle of aerodynamic energy. Particular emphasis is placed on the derivation of an analytical expression for the law governing the motion of the tab at the instability boundary under the assumption that the tab control system is an ideal one. B.J.

A84-41777#

AN APPROXIMATE SOLUTION OF AIRCRAFT LATERAL-DIRECTIONAL LIMIT CYCLE OSCILLATION INDUCED BY AERODYNAMIC HYSTERESIS

C. LIU (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, March 1984, p. 11-17. In Chinese, with abstract in English. refs

Wind tunnel tests on aircraft models often demonstrate that the variation of lateral-directional rolling and yawing moments with the yaw angle gives evidence that aerodynamic hysteresis occurred at high angle of attack. The nonlinear additional increments of the moment due to aerodynamic hysteresis are linearized by the harmonic linear method. Then, based on the harmonic balance method, an approximate analytical formula is derived for determining the characteristics of aircraft lateral-directional limit cycle oscillation induced by aerodynamic hysteresis. Calculations by this method show that the results are in good agreement with data obtained by the numerical iterating method. The method eliminates the shortcoming that the amplitude of roll rate limit cycle oscillation induced by roll hysteresis is not the maximum. Author

A84-41778#

SELECTION OF SAS' LONGITUDINAL FEEDBACK COEFFICIENTS TO IMPROVE RIDING QUALITIES

H. GAO (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, March 1984, p. 18-23. In Chinese, with abstract in English.

The longitudinal feedback coefficients of a stability augmentation system (SAS) for a sample aircraft were selected under the condition that the normal acceleration response at the pilot's position approximated zero. The improvement in riding qualities of

the airframe/SAS system due to the selected coefficients was evaluated. The dynamic characteristics of the airframe/SAS system were also analyzed. The results demonstrate that the riding qualities are desirable when the control anticipative parameter of the airframe/SAS system approaches to 9.81/l(x), and the operating range of the SAS is limited to the elevator displacement less than 10 percent of the maximum displacement. It is necessary to take into account the lift due to the elevator deflection in the analysis of the dynamic characteristics of the airframe/SAS system, if the tail area is large enough in comparison with the wing area. Author

A84-42148

OPTIMAL CONTROLLERS FOR BANK-TO-TURN CLOSURE GUIDANCE

D. J. RODDY, G. W. IRWIN (Queen's University, Belfast, Northern Ireland), and H. WILSON (Short Brothers Ltd., Belfast, Northern Ireland) IEE Proceedings, Part D - Control Theory and Applications (ISSN 0143-7054), vol. 131, July 1984, p. 109-116. Research supported by the Department of Education of Northern Ireland and Short Brothers Ltd. refs

Linear quadratic optimal control theory is applied to the problem of bank-to-turn control in a CLOS guidance system. Both stationary and moving targets are treated, and the trade-off between controller complexity and autopilot realizability examined. The optimality of conventional control ideas is assessed. Finally, simulation results using a practical autopilot model confirm that these new controllers give improved guidance accuracy and reduced susceptibility to pitch-yaw crosscoupling. Author

A84-42277*

TESTING OF A STALL FLUTTER SUPPRESSION SYSTEM FOR HELICOPTER ROTORS USING INDIVIDUAL-BLADE-CONTROL

T. R. QUACKENBUSH American Helicopter Society, Journal (ISSN 0002-8711), vol. 29, July 1984, p. 38-44. NASA-supported research. refs

The development and testing of a feedback system designed to alleviate rotor blade first torsion mode oscillations associated with stall flutter are described. The system employs blade-mounted sensors to detect torsional oscillations and provide feedback in order to increase the damping of the first torsional mode. A model of the blade and control system dynamics is developed and is used to give qualitative and quantitative guidance in the design process, as well as to aid in the analysis of experimental results. System performance in wind tunnel tests in forward flight is described, and experimental results show that the system can provide substantial additional damping to stall-induced oscillations. Author

A84-42279

A SIMPLE AUTOROTATIVE FLARE INDEX

E. A. FRADENBURGH (Sikorsky Aircraft, Stratford, CT) American Helicopter Society, Journal (ISSN 0002-8711), vol. 29, July 1984, p. 73, 74.

An index which corresponds to the relative ease with which a helicopter can make an autorotative flare to a landing is derived from simple momentum relations. The index is proportional to rotor kinetic energy and inversely proportional to the product of gross weight and disk loading. As gross weight of a given helicopter is increased, the value of the index decreases rapidly. Operation at altitude decreases the index for any given weight. Although it does not account for some factors which influence the capability for a safe power-off landing, such as landing gear design and pilot visibility, the index is a useful guide whenever other elements are approximately equal. Author

A84-42314

FLIGHT CONTROL SYSTEM SYNTHESIS USING EIGENSTRUCTURE ASSIGNMENT

E. Y. SHAPIRO and J. C. CHUNG (Lockheed-California Co., Burbank, CA) *Journal of Optimization Theory and Applications* (ISSN 0022-3239), vol. 43, July 1984, p. 415-429. refs

The central topic of this paper is the establishment of an efficient practical synthesis procedure for modern flight control systems. Unlike the classical design methodology (Bode plots, Nichols plot, etc.) and optimal control techniques, the present approach provides the designer a direct approach for the synthesis of desired control laws. Although the setting is the now familiar state space, the actual design is performed relative to classical specifications (i.e., modes and mode distribution) by placing closed-loop eigenvalues and eigenvectors at some desired locations (regions) within the state space. The new method can handle output feedback configurations, subject to controller structural constraints. Complete theoretical background and a realistic numerical example are provided. Author

A84-42327*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

MORE THAN YOU MAY WANT TO KNOW ABOUT MAXIMUM LIKELIHOOD ESTIMATION

K. W. ILIFF and R. E. MAINE (NASA, Flight Research Center, Edwards, CA) *IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers*. New York, American Institute of Aeronautics and Astronautics, 1984, p. 1-24. refs

(AIAA PAPER 84-2070)

A discussion is undertaken concerning the maximum likelihood estimator and the aircraft equations of motion it employs, with attention to the application of the concepts of minimization and estimation to a simple computed aircraft example. Graphic representations are given for the cost functions to help illustrate the minimization process. The basic concepts are then generalized, and estimations obtained from flight data are evaluated. The example considered shows the advantage of low measurement noise, multiple estimates at a given condition, the Cramer-Rao bounds, and the quality of the match between measured and computed data. O.C.

A84-42329*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT INVESTIGATION OF VARIOUS CONTROL INPUTS INTENDED FOR PARAMETER ESTIMATION

M. F. SHAFER (NASA, Flight Research Center, Edwards, CA) *IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers*. New York, American Institute of Aeronautics and Astronautics, 1984, p. 33-49. refs

(AIAA PAPER 84-2073)

NASA's F-8 digital fly-by-wire aircraft has been subjected to stability and control derivative assessments, leading to the proposal of improved control inputs for more efficient control derivative estimation. This will reduce program costs by reducing flight test and data analysis requirements. Inputs were divided into sinusoidal types and cornered types. Those with corners produced the best set of stability and control derivatives for the unaugmented flight control system mode. Small inputs are noted to have provided worse derivatives than larger ones. O.C.

A84-42330*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT CHARACTERISTICS OF A MANNED, LOW-SPEED, CONTROLLED DEEP STALL VEHICLE

A. G. SIM (NASA, Flight Research Center, Edwards, CA) *IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers*. New York, American Institute of Aeronautics and Astronautics, 1984, p. 50-56. refs

(AIAA PAPER 84-2074)

A successful manned, low-speed, controlled deep stall flight research program was conducted at NASA Ames Research Center's Dryden Flight Research Facility. Piloting techniques were

established that enabled the pilot to attain and stabilize on an angle of attack in the 30 to 72 deg range. A flight-determined aerodynamic data base was established for angles of attack as high as 72 deg. Poor lateral-directional flying qualities were encountered at angles of attack above 60 deg. Insight into the high angle-of-attack, lateral-directional dynamics was gained through a basic root-locus analysis. Author

A84-42331#

THE NUMERICAL COMPUTATION OF AIRPLANE RESPONSE TO ARBITRARY VERTICAL GUST DISTRIBUTIONS

C. QUI, Z. YAN, W. ZHOU (Jiaotong University, Shanghai, People's Republic of China), and J. AN *IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers*. New York, American Institute of Aeronautics and Astronautics, 1984, p. 57-70. refs

(AIAA PAPER 84-2075)

The subsonic longitudinal component of the Chinese Aerodynamic Research and Development Center project on aircraft gust response property numerical computation has been employed in practical design work. Gust types may be either discrete or continuous, with an arbitrary velocity distribution. Aircraft configurations may also be arbitrary. Aerodynamic, flight dynamic, structural aeroelasticity and controlled equations are solved in succession for several tens of thousands of time intervals dividing the gust-disturbed flight path. The Method of Finite Element Solutions is used to calculate unsteady aerodynamic loadings over wing and tail surfaces. A novel, parallelogram-based paneling method is suggested to reduce the number of influence coefficients. O.C.

A84-42336#

FREE-FALLING AUTOROTATING PLATE - A COUPLED FLUID AND FLIGHT MECHANICS PROBLEM

C. R. GALLAWAY (USAF, Wright-Aeronautical Laboratories, Wright-Patterson AFB, OH; U.S. Defense Intelligence Agency, Washington, DC) and W. L. HANKEY (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) *IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers*. New York, American Institute of Aeronautics and Astronautics, 1984, p. 105-111. refs

(AIAA PAPER 84-2080)

A computational method coupling the three degrees of freedom flight mechanics equations and the two dimensional time dependent Navier-Stokes equations was developed which could be used to predict the autorotating characteristics of a free falling, two dimensional flat plate. The two dimensional, incompressible Navier-Stokes equations were cast in a body fixed coordinate system. The corresponding velocities were cast in an inertial reference system. The Navier-Stokes equations were represented by backward-time-central-space finite differences and solved using a successive-overrelaxation iteration technique. The resulting aerodynamic coefficients were entered into the three degrees of freedom flight mechanics equations. The system of ordinary differential equations describing the flight mechanics was solved using an Adams-Bashforth explicit method to predict the movement of the plate. New values of the boundary conditions for the Navier-Stokes equations solver were obtained from this movement of the plate. The process was repeated to advance the solution in time. The flight path of a free falling autorotating plate was predicted using the computational procedure and the validity of the overall approach demonstrated by comparison with experiment. Author

A84-42337#

PRACTICAL ASPECTS OF HELICOPTER PARAMETER IDENTIFICATION

J. KALETKA (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugmechanik, Brunswick, West Germany) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 112-122. refs (AIAA PAPER 84-2081)

A high flight test data accuracy is a major prerequisite for a reliable system identification. Therefore the paper first concentrates on a technique that makes it possible to assess the compatibility of measured data immediately during the flight test phase. This approach, based on the least squares criterion, is described and its feasibility to detect calibration errors is demonstrated. Then emphasis is placed on the extraction of flight mechanical parameters from BO 105 flight test data. Using airspeed measurements as example, the influence of measurement deficiencies on identification results is discussed and it is shown that the results can be improved when a nonlinear maximum likelihood identification method is applied. Finally, the verification of identified helicopter models is addressed. Author

A84-42340*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A PRELIMINARY ANALYSIS OF FLIGHT DATA FROM THE AFTI/F-16 AIRPLANE

J. G. BATTERSON (NASA, Langley Research Center, Hampton, VA) and V. KLEIN (Joint Institute for Advancement of Flight Sciences, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 140-147. refs (AIAA PAPER 84-2085)

Flight test data from the AFTI/F-16 airplane are analyzed. Two flight control system modes (Independent Backup Unit and Standard Normal Mode) are considered. Estimated stability and control derivatives are compared with values from the wind tunnel and F-16A flight tests. Modeling difficulties are shown to arise due to the near-neutral static stability of the airplane and the number of coordinated control surface movements commanded in the Standard Normal Mode. Author

A84-42341#

DETERMINATION OF AV-8B FLYING QUALITIES BY NONLINEAR PARAMETER IDENTIFICATION

L. C. ANDERSON (Systems Control Technology, Inc., Palo Alto, CA) and J. V. FOSTER (U.S. Navy, Naval Air Test Center, Patuxent River, MD) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 148-156. (AIAA PAPER 84-2086)

This paper describes how a high fidelity simulation of the AV-8B V/STOL aircraft was used to help investigate flight characteristics and determine mission capability during the full scale development (FSD) flight test program. System identification techniques were used to incorporate the results of flight testing into the aerodynamic and propulsion model, including identification of jet-induced aerodynamic effects. The resulting model was used for analysis of longitudinal stability, for prediction of short takeoff (STO) characteristics, and for other tasks in support of the flight test program. Author

A84-42346*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HANDLING QUALITIES RELATED TO STALL/SPIN ACCIDENTS OF SUPERSONIC FIGHTER AIRCRAFT

S. B. ANDERSON (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 198-208. refs (AIAA PAPER 84-2093)

This paper reviews the handling qualities which influence the high angle of attack (AOA) behavior of supersonic fighter aircraft in order to obtain a clearer understanding of the causes of stall/spin accidents. The results show that, because modern fighters suffer more serious consequences when control is lost, good handling qualities are essential for safe operation at high AOA. Relaxed static stability used on some fighter aircraft can result in control problems at high AOA owing to inertia coupling and the difficulty of a recovery from a deep stall. Indications are that the use of departure/spin resistance and an automatic spin prevention system will greatly improve the safety record for modern supersonic fighters. Author

A84-42347#

LIMITED EVALUATION OF THE LONGITUDINAL FLYING QUALITIES OF A CENTERSTICK CONTROLLED NT-33A AIRCRAFT WITH VARIATIONS IN STICK FORCE PER G AND STICK FORCE PER INCH

W. M. QUINN, JR. (USAF, Hickam AFB, HI) and M. A. CUTCHINS (Auburn University, Auburn, AL) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 209-217. refs (AIAA PAPER 84-2094)

A two-phase study was performed using the USAF NT-33A variable stability aircraft to simulate a Class IV centerstick-controlled aircraft during Category A flight phases. In Phase I the effect of variations in stick force per g and stick force per inch on longitudinal flying qualities was evaluated using air-to-air tracking of a target aircraft. In Phase II, all configurations evaluated in Phase I were reevaluated using a Head-Up Display (HUD) command tracking task. Results from the evaluations with a target aircraft were compared to the results obtained using HUD command tracking. Cooper-Harper ratings consistently worse than 3.5 and pilot comments corresponding to Level 2 performance were obtained during all phases. Both test phases indicated that a stick force per g of 10 lbs/g was too high and a stick force per inch of 4 lbs/in. was too low for favorable comments and ratings. In both Phase I and Phase II the combination of 7 lbs/g with 6 lbs/in. and 7 lbs/g with 8 lbs/in. received the best ratings and comments. Phase II evaluations were consistent with those from Phase I, and the use of the HUD command tracking task was adequate to reveal potential flying qualities problems. Pilot comments were more consistent than Cooper-Harper ratings. Author

A84-42354*# Flight Systems, Inc., Newport Beach, Calif.

IMPACT OF FLYING QUALITIES ON MISSION EFFECTIVENESS FOR HELICOPTER AIR COMBAT

T. M. HARRIS, D. A. BEERMAN (Flight Systems, Inc., Newport Beach, CA), and C. C. BIVENS (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 286-293. (Contract NAS2-11178) (AIAA PAPER 84-2106)

Battlefield nap-of-the-earth (NOE) helicopter operations are vital for a use of the helicopter in a high-threat environment. As the pilot's workload in this flight regime is very high, the helicopter's handling qualities become an important factor. The present investigation is concerned with overall mission effectiveness, flying qualities, and their interaction with other parameters. A description is presented of a study which generated a significant amount of data relating the importance of flying qualities to the ability to

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perform several specific mission tasks. It was found that flying qualities do have a major impact on the ability to perform a specific mission. The impact of flying qualities on Scout helicopter mission effectiveness is mainly related to the probability of being detected. The flying qualities effect most critical to the Scout mission was found to be precision of hover control. G.R.

A84-42357*# Indian Inst. of Tech., Bombay.

ON THE PREDICTION OF AUTO-ROTATIONAL CHARACTERISTICS OF LIGHT AIRPLANE FUSELAGES

B. N. PAMADI (Indian Institute of Technology, Bombay, India) and L. W. TAYLOR, JR. (NASA, Langley Research Center, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 323-333. refs (AIAA PAPER 84-2112)

A semi-empirical theory is presented for the estimation of aerodynamic forces and moments acting on a steadily rotating (spinning) airplane fuselage, with a particular emphasis on the prediction of its auto-rotational behavior. This approach is based on an extension of the available analytical methods for high angle of attack and side-slip and then coupling this procedure with strip theory for application to a rotating airplane fuselage. The analysis is applied to the fuselage of a light general aviation airplane and the results are shown to be in fair agreement with experimental data. Author

A84-42372*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A PRELIMINARY LOOK AT THE EFFECTS OF COUPLED LATERAL MODES ON AIRCRAFT HANDLING QUALITIES

S. J. RUFLIN and W. D. GRANTHAM (NASA, Langley Research Center, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 471-483. refs (AIAA PAPER 84-2096)

Analytic and six-degree-of-freedom motion base simulator studies have been conducted to better understand how the coupled roll-spiral and coupled roll-aileron actuator modes affect aircraft handling qualities. The results reported herein are preliminary and are subject to change until other aircraft and several more data points can be examined. The results obtained thus far indicate that when the roll-spiral coupled mode is brought about by unusual values of an aircraft's stability and control derivatives, the lateral-directional handling qualities will invariably be degraded. However, when the roll spiral coupling is brought about by a roll-rate command/roll-attitude hold stability and control augmentation system (SCAS), the requirements for satisfactory handling qualities can be correlated to the natural frequency and the damping of the coupled mode. Satisfactory handling qualities were also achieved when the lateral SCAS brought about a coupling of the roll mode with the aileron actuator mode. In this case, the pilot ratings indicate that the handling qualities may be correlated to the natural frequency of the coupled roll-aileron mode. Author

A84-42375#

A COMPARISON OF FIXED-BASE AND IN-FLIGHT LONGITUDINAL HANDLING QUALITIES SIMULATIONS

J. R. WOOD (McDonnell Aircraft Co., St. Louis, MO) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 500-508. refs (AIAA PAPER 84-2104)

A fixed-base longitudinal handling qualities simulation was used to replicate the Neal-Smith and Two Phase in-flight simulations and determine the effects of fixed-base simulation on pilot rating. Variations in longitudinal dynamics defined the simulation test matrix. The effects of evaluation task on pilot rating were investigated, and pilots found close, maneuvering target tasks more demanding than distant, stationary target tasks. The fixed-base pilot ratings showed enough consistency to be reliable, and the correlation between the two types of simulation was good. Analysis

using equivalent system parameters showed that many of the differences in pilot rating could be attributed to high short-period frequency, low short-period damping ratio, or large time delays. Also, the equivalent systems of selected configurations were evaluated and the pilot ratings agreed with those of the high order dynamics for both fixed-base and in-flight evaluations. Author

A84-42376*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PRELIMINARY RESULTS OF EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF THE TUMBLING PHENOMENON FOR AN ADVANCED CONFIGURATION

R. D. WHIPPLE, M. A. CROOM (NASA, Langley Research Center, Hampton, VA), and S. P. FEARS (Joint Institute for Advancement of Flight Sciences, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 509-518. refs (AIAA PAPER 84-2108)

A sustained autorotative pitching motion usually called 'tumbling' has been observed during dynamic model tests of the X-29A configuration. The X-29 is an advanced design incorporating forward-swept wings and canards in a highly relaxed static stability condition. Beginning with a historical review of the tumbling phenomenon, this paper discusses the current experimental results of dynamic model tumbling tests of the X-29 and the initial efforts to establish an aerodynamic and mathematical model for analysis. Author

A84-42381

SUBOPTIMAL TRAJECTORY FOLLOWING DURING FLARE MANEUVERS IN PRESENCE OF WIND SHEARS

A. A. NADKARNI (Boeing Commercial Airplane Co., Seattle, WA) IN: Annual Pittsburgh Conference, 13th, Pittsburgh, PA, April 22, 23, 1982, Proceedings. Part 1. Research Triangle Park, NC, Instrument Society of America, 1982, p. 35-44. refs

A successful suboptimal control strategy for following a nominal flare trajectory during transition from glideslope to desired touchdown conditions is presented. The nominal trajectory is generated in the absence of wind disturbances by forcing ramp commands on the controls. Both wind turbulence and wind shear are included in the aircraft equations of motion. The turbulence disturbances are included with the usual Dryden model. The shear disturbances are modeled as spatial disturbances, appropriately transformed, and included in the equations of motion. The problem is then posed as an optimal, discrete regulator problem acted on by a constant disturbance, and a set of state-feed gain matrices is computed for each wind shear condition. The difference between the actual and nominal trajectories is used to generate the feedback controls; these are added to the forced ramp commands to yield the total control needed to follow the nominal trajectory. C.D.

N84-28801*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SPACE SHUTTLE SEPARATE-SURFACE CONTROL-SYSTEM STUDY

L. W. BROWN and R. C. MONTGOMERY Jul. 1984 59 p refs (NASA-TP-2340; L-15650; NAS 1.60:2340) Avail: NTIS HC A04/MF A01 CSCI 01C

A control system concept is presented that produces proportional control of yaw moment for the space shuttle from early entry to Mach 2 with only software modifications of the vehicle. It uses separate deflections of the inboard and outboard elevon surfaces and is evaluated, by determining the maximum static yawing moment available by considering the deflection limits of the elevon surfaces. A proportional moment slightly in excess of that produced by the most effective reaction control system (RCS) jet for yaw control can be obtained. In addition to the static moment study, a control law is designed which is intended to produce desired flying qualities. M.A.C.

N84-28802*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.

INTEGRATED APPLICATION OF ACTIVE CONTROLS (IAAC) TECHNOLOGY TO AN ADVANCED SUBSONIC TRANSPORT PROJECT: CURRENT AND ADVANCED ACT CONTROL SYSTEM DEFINITION STUDY, VOLUME 1 Final Report, Jul. 1978 - Oct. 1980

G. W. HANKS, H. A. SHOMBER, H. A. DETHMAN, L. B. GRATZER, A. MAESHIRO, D. GANGSAAS, J. D. BLIGHT, S. M. BUCHAN, C. B. CRUMB, R. J. DORWART et al. Oct. 1981 521 p refs (Contract NAS1-14742; NAS1-15325) (NASA-CR-165631-VOL-1; NAS 1.26:165631-VOL-1; D6-48673-VOL-1) Avail: NTIS HC A22/MF A01 CSCL 01C

An active controls technology (ACT) system architecture was selected based on current technology system elements and optimal control theory was evaluated for use in analyzing and synthesizing ACT multiple control laws. The system selected employs three redundant computers to implement all of the ACT functions, four redundant smaller computers to implement the crucial pitch-augmented stability function, and a separate maintenance and display computer. The reliability objective of probability of crucial function failure of less than 1×10^{-10} to the -9th power per flight of 1 hr can be met with current technology system components, if the software is assumed fault free and coverage approaching 1.0 can be provided. The optimal control theory approach to ACT control law synthesis yielded comparable control law performance much more systematically and directly than the classical s-domain approach. The ACT control law performance, although somewhat degraded by the inclusion of representative nonlinearities, remained quite effective. Certain high-frequency gust-load alleviation functions may require increased surface rate capability. A.R.H.

N84-28803*# Boeing Commercial Airplane Co., Seattle, Wash. **INTEGRATED APPLICATION OF ACTIVE CONTROLS (IAAC) TECHNOLOGY TO AN ADVANCED SUBSONIC TRANSPORT PROJECT: CURRENT AND ADVANCED ACT CONTROL SYSTEM DEFINITION STUDY. VOLUME 2: APPENDICES Final Report**

G. W. HANKS, H. A. SHOMBER, H. A. DETHMAN, L. B. GRATZER, A. MAESHIRO, D. GANGSAAS, J. D. BLIGHT, S. M. BUCHAN, C. B. CRUMB, and R. J. DORWART Oct. 1981 542 p refs (Contract NAS1-14742; NAS1-15325) (NASA-CR-165631-VOL-2; NAS 1.26:165631-VOL-2) Avail: NTIS HC A23/MF A01 CSCL 01C

The current status of the Active Controls Technology (ACT) for the advanced subsonic transport project is investigated through analysis of the systems technical data. Control systems technologies under examination include computerized reliability analysis, pitch axis fly by wire actuator, flap actuation system design trade study, control law synthesis and analysis, flutter mode control and gust load alleviation analysis, and implementation of alternative ACT systems. Extensive analysis of the computer techniques involved in each system is included. M.A.C.

N84-28804*# Boeing Commercial Airplane Co., Seattle, Wash. Preliminary Design Dept.

INTEGRATED APPLICATION OF ACTIVE CONTROLS (IAAC) TECHNOLOGY TO AN ADVANCED SUBSONIC TRANSPORT PROJECT-DEMONSTRATION ACT SYSTEM DEFINITION Final Report, Nov. 1980 - Jun. 1981

G. W. HANKS, H. A. SHOMBER, C. B. CRUMB, C. C. FLORA, K. A. B. MACDONALD, R. D. SMITH, A. P. SASSI, and R. J. DORWART Aug. 1982 67 p refs (Contract NAS1-15325) (NASA-CR-165920; NAS 1.26:165920; D6-51148) Avail: NTIS HC A04/MF A01 CSCL 01C

The 1985 ACT airplane is the Final Active Controls Technology (ACT) Airplane with the addition of three-axis fly by wire. Thus it retains all the efficiency features of the full ACT system plus the weight and cost savings accruing from deletion of the mechanical control system. The control system implements the full IAAC spectrum of active controls except flutter-mode control, judged

essentially nonbeneficial, and incorporates new control surfaces called flaperons to make the most of wing-load alleviation. This redundant electronic system is conservatively designed to preserve the extreme reliability required of crucial short-period pitch augmentation, which provides more than half of the fuel savings.

Author

N84-28805*# Lockheed-California Co., Burbank. **DEVELOPMENT AND FLIGHT EVALUATION OF AN AUGMENTED STABILITY ACTIVE CONTROLS CONCEPT WITH A SMALL HORIZONTAL TAIL Report, Dec. 1978 - Apr. 1982**

J. J. RISING, A. A. KAIRYS, C. A. MAASS, C. D. SIEGART, W. L. RAKNESS, R. D. MIJARES, R. W. KING, R. S. PETERSON, S. R. HURLEY, D. WICKSON et al. Hampton, Va. NASA. Langley Research Center 1 Sep. 1982 182 p refs (Contract NAS1-15326)

(NASA-CR-165951; NAS 1.26:165951; LR-30208-2) Avail: NTIS HC A09/MF A01 CSCL 01C

A limited authority pitch active control system (PACS) was developed for a wide body jet transport (L-1011) with a flying horizontal stabilizer. Two dual channel digital computers and the associated software provide command signals to a dual channel series servo which controls the stabilizer power actuators. Input sensor signals to the computer are pitch rate, column-trim position, and dynamic pressure. Control laws are given for the PACS and the system architecture is defined. The piloted flight simulation and vehicle system simulation tests performed to verify control laws and system operation prior to installation on the aircraft are discussed. Modifications to the basic aircraft are described. Flying qualities of the aircraft with the PACS on and off were evaluated. Handling qualities for cruise and high speed flight conditions with the c.g. at 39% mac (+ 1% stability margin) and PACS operating were judged to be as good as the handling qualities with the c.g. at 25% (+15% stability margin) and PACS off. Author

N84-28806*# Sikorsky Aircraft, Stratford, Conn. **UH-60A BLACK HAWK ENGINEERING SIMULATION PROGRAM. VOLUME 1: MATHEMATICAL MODEL Final Report**

J. J. HOWLETT Dec. 1981 359 p refs (Contract NAS2-10626)

(NASA-CR-166309; NAS 1.26:166309; SER-70452) Avail: NTIS HC A16/MF A01 CSCL 01C

A nonlinear mathematical model of the UH-60A Black Hawk helicopter was developed. This mathematical model, which was based on the Sikorsky General Helicopter (Gen Hel) Flight Dynamics Simulation, provides NASA with an engineering simulation for performance and handling qualities evaluations. This mathematical model is total systems definition of the Black Hawk helicopter represented at a uniform level of sophistication considered necessary for handling qualities evaluations. The model is a total force, large angle representation in six rigid body degrees of freedom. Rotor blade flapping, lagging, and hub rotational degrees of freedom are also represented. In addition to the basic helicopter modules, supportive modules were defined for the landing interface, power unit, ground effects, and gust penetration. Information defining the cockpit environment relevant to pilot in the loop simulation is presented. Author

N84-28807*# Honeywell Systems and Research Center, Minneapolis, Minn.

INTERACTIVE FLIGHT CONTROL SYSTEM ANALYSIS PROGRAM Final Report

J. K. MAHESH, A. F. KONAR, and M. D. WARD Jun. 1984 20 p refs

(Contract NAS1-16438)

(NASA-CR-172352; NAS 1.26:172352; REPT-84SRC10) Avail: NTIS HC A02/MF A01 CSCL 01C

A summary of the development, use, and documentation of the interactive software (DIGIKON IV) for flight control system analyses is presented. A list of recommendations for future development is also included. Author

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N84-28808*# National Aeronautics and Space Administration, Washington, D. C.

DESIGN OF WIND SHEAR FILTERS

H. JOERCK May 1984 17 p refs Transl. into ENGLISH from "Auslegung von Scherwindfiltern" Brunswick, IN: Sonderforschungsbereich Flugfuehrung, Kolloq., 1982 p 261-276 Original language doc. was announced as A83-26483 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Technische Univ., Brunswick, West Germany (Contract NASW-3542) (NASA-TM-77460; NAS 1.15:77460) Avail: NTIS HC A02/MF A01 CSCL 01C

A number of aircraft accidents are caused by the effects of wind shear. In connection with efforts to eliminate or reduce hazards leading to such accidents, the possibility was considered to improve aircraft control systems. However, the effective implementation of the considered approaches will only be possible if suitable filters can be designed for a separation of gusts, which involve higher frequencies from low-frequency wind shear components. Filters of appropriate design should be suited for an employment in connection with all flight conditions. Feasible approaches for obtaining such filters are discussed. A survey is provided regarding the order of magnitude of the improvements which can be achieved, taking into account the performance characteristics of the A300 controller. R.J.F.

N84-28809*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

A REVIEW OF US ARMY AIRCREW-AIRCRAFT INTEGRATION RESEARCH PROGRAMS

D. C. KEY and E. W. AIKEN Jul. 1984 18 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif. (NASA-TM-85947; A-9717; NAS 1.15:85947; USAAVSCOM-TM-84-A-5) Avail: NTIS HC A02/MF A01 CSCL 01C

If the U.S. Army's desire to develop a one crew version of the Light Helicopter Family (LHX) helicopter is to be realized, both flightpath management and mission management will have to be performed by one crew. Flightpath management, the helicopter pilot, and the handling qualities of the helicopter were discussed. In addition, mission management, the helicopter pilot, and pilot control/display interface were considered. Aircrew-aircraft integration plans and programs were reviewed. R.S.F.

N84-28810# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

DEVELOPMENT OF LATERAL-DIRECTIONAL EQUIVALENT SYSTEM MODELS FOR SELECTED U.S. NAVY TACTICAL AIRCRAFT Final Report, 1 Oct. 1981 - 30 Nov. 1982

D. E. BISCHOFF and R. E. PALMER Sep. 1983 100 p (AD-A141672; NADC-83116-60) Avail: NTIS HC A05/MF A01 CSCL 01C

The high order transfer functions representing the lateral directional responses to pilot control inputs were matched with low order equivalent forms in the frequency domain for five Navy tactical aircraft: the A-6, A-7, S-3, F-14, and F-18. The candidate low order equivalent forms investigated were: (1) the complete three degree of freedom representation of roll and sideslip angle responses, and (2) the single degree of freedom roll mode and Dutch roll approximations. Acceptable models were generally obtained for both forms. Simultaneous matching of sideslip and roll angle responses and/or apriori information for the roots was required to match the full three degree of freedom forms. The equivalent system models are discussed in terms of their match statistics. The equivalent system modal parameters, when compared against the requirements of the military flying qualities specification, demonstrate level 1 flying qualities for the conditions analyzed with the exception of roll angle time delay for the A-7 and F-18 airplanes. The A-7's lateral command augmentation structure results in Level 2-3 equivalent time delays, while the F-18's control force inputs produce level 2 equivalent time delays.

Author (GRA)

N84-28811# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

UNSTEADY AERODYNAMICS OF MOVING CONTROL SURFACES AT THE AIRBUS WING Final Report, Jan. 1983

G. ANDERS Bonn Bundesministerium fuer Forschung und Technologie Mar. 1984 23 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-W-84-001; ISSN-0170-1339) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5

Steady and unsteady tests were carried out in a transonic tunnel on moving control surfaces of the European Airbus wing. A data bank containing the measured configurations of spoilers, flaps, and ailerons is obtained. Author (ESA)

N84-29883*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

DESIGN OF A CANDIDATE FLUTTER SUPPRESSION CONTROL LAW FOR DAST ARW-2

W. M. ADAMS, JR. and S. H. TIFFANY Jul. 1984 28 p refs Presented at the AIAA Guidance and Control Conf., Gatlinburg, Tenn., 15-17 Aug. 1983 (NASA-TM-86257; NAS 1.15:86257; AIAA-83-2221) Avail: NTIS HC A03/MF A01 CSCL 01C

A control law is developed to suppress symmetric flutter for a mathematical model of an aeroelastic research vehicle. An implementable control law is attained by including modified LQC (Linear Quadratic Gaussian) design techniques, controller order reduction, and gain scheduling. An alternate (complementary) design approach is illustrated for one flight condition wherein nongradient-based constrained optimization techniques are applied to maximize controller robustness. Author

N84-29884*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

FLIGHT INVESTIGATION OF VARIOUS CONTROL INPUTS INTENDED FOR PARAMETER ESTIMATION

M. F. SHAFFER Aug. 1984 20 p refs Presented at the AIAA Atmospheric Flight Mech. Conf., Seattle, 21-23 Aug. 1984 (NASA-TM-85901; H-1245; NAS 1.15:85901) Avail: NTIS HC A02/MF A01 CSCL 01C

An experiment assessing the stability and control derivatives resulting from various control inputs was undertaken using the F-8 digital fly by wire aircraft. Improved control inputs have been proposed as a means of making stability and control derivative estimation more efficient, thus reducing the cost of flight testing and data analysis. The subject inputs were either generated by the pilot or preprogrammed in a remote ground computer and telemetered to the aircraft. Nine preprogrammed inputs and three pilot generated inputs were assessed at subsonic and supersonic flight conditions, and both unaugmented and highly augmented flight control systems were used. Effects of input amplitude were also assessed. The inputs were divided into two general types - sinusoidal or with corners (a rapid and distinct change in slope). The inputs with corners, performed in the unaugmented mode, produced the best sets of stability and control derivatives. The simplest of these inputs, the pilot generated doublet, produced sets of derivatives as good as those produced by the more complex inputs. Small inputs produced worse derivatives than the unaugmented mode, and sinusoidal inputs produced worse derivatives than corner containing inputs. B.W.

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N84-29885* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATOR EVALUATION OF A REMOTELY PILOTED VEHICLE LATERAL LANDING TASK USING A VISUAL DISPLAY Final Report

S. K. SARRAFIAN Aug. 1984 16 p refs Presented at the AIAA Atmospheric Flight Mech. Conf., Seattle, 21-23 Aug. 1984 (NASA-TM-85903; H-1246; NAS 1.15:85903) Avail: NTIS HC A02/MF A01 CSCL 01C

A simulator evaluation of a remotely piloted research vehicle was conducted at NASA Ames Research Center's Dryden Flight Research Facility to determine the utility of a visual display when studying the influence of changes in the lateral stick gearing gains during landing approaches. The test vehicle used in this study was a highly maneuverable aircraft technology (HiMAT) aircraft, which is a 0.44 scale version of an envisioned small, single seat fighter airplane. Handling qualities ratings and comments obtained from pilots using a simulated visual display of a runway scene and a simulated instrument landing system (ILS) display were compared with the results of actual flight tests. The visual display was found to provide an adequate representation of the test vehicle in a visual landing approach, and it improved the roll response cues provided to the pilot. The handling qualities ratings and comments for flight and simulation visual landing approaches correlated well. The ILS simulation results showed reduced correlation compared with the flight results for ILS approaches. Handling qualities criteria for remotely piloted research vehicles are also discussed in this paper. Author

N84-29886* National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

REVIEW AND COMPARISON OF DISCRETE AND CONTINUOUS GUST METHODS FOR THE DETERMINATION OF AIRPLANE DESIGN LOADS

R. NOBACK 17 Dec. 1982 69 p refs
(Contract RB-RLD-1982:1.1.2)
(NLR-TR-82134-U) Avail: NTIS HC A04/MF A01

The discrete gust and the continuous gust concepts of airplane load determination are reviewed, and the discrete gust method and the power spectral density method are compared using simple airplane models. No direct relation between the two methods exists. The main cause of the discrepancy is the difference in the relation between gust velocity and gust length in the two gust models.

Author (ESA)

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RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A84-40023

REHABILITATION OF THE MAURITIUS ISLAND PLAISANCE AIRPORT UPGRADING THE RUNWAY [ILE MAURICE REAMENAGEMENT DE L'AEROPORT DE PLAISANCE - TRAVAUX DE RECHARGEMENT DE LA PISTE]

J.-L. DAUJE (Aeroport de Paris, Paris, France) and B. BLANC Revue Generale des Routes et des Aerodromes (ISSN 0035-3191), June 1984, p. 22-29. In French.

The present and planned facilities of the Mauritius Island (off the SE coast of Africa) airport are described, together with work-in-progress. The airport will have resurfaced runways, a new control tower and new radio-navigation equipment. The runway surface will be expanded to 13,000 sq m and elongated to 2900 m. The control tower's position will be at 430 m from the middle of the runway. Air-conditioning will be installed in the airport waiting area and a hangar capable of housing a 747 will be built. Roads will be built around the airport to handle increased traffic expected

by the end of the century. Techniques are being implemented to seal large cracks which appear in the present runway surface.

M.S.K.

A84-40024

REPAIRS WITHOUT INTERRUPTION OF THE AIR TRAFFIC ON THE RUNWAY OF THE GENEVA-COINTRIN AIRPORT [REFECTION SANS INTERRUPTION DU TRAFIC AERIEN DE LA PISTE DE L'AEROPORT DE GENEVE-COINTRIN]

M. WALDBURGER (Zuerich, Eidgenossische Technische Hochschule, Zurich, Switzerland) Revue Generale des Routes et des Aerodromes (ISSN 0035-3191), June 1984, p. 31-34. In French.

Since 1978, 20,500 sq m of runway surface at the Geneva-Cointrin airport have been repaired using prefabricated asphalt slabs. No service interruption has been necessary because resurfacing efforts have been carried out between midnight and 5 AM, when the airport is not active. Repair materials have included the asphalt slabs for the surface and liquid mortar injected to fill subsurface cracks. Old slab sections have been lifted, a new gravel bed laid down, a layer of cement poured and the precast slab set on top. New plastic drainage tiles have been emplaced where necessary. The runway is 24 m wide and the new asphalt slabs, carried by a specially-designed vehicle, have been 12 x 12 m in size. The resurfacing has been performed to a maximum depth of 50 cm. M.S.K.

A84-40117

THE OPERATION OF THE FACILITIES OF AIR TRAFFIC CONTROL [EKSPLOATATSIIA SREDSTV UPRAVLENNIA VOZDUSHNYM DVIZHENIEM]

A. A. KUZNETSOV, V. I. DUBROVSKII, and A. S. ULANOV Moscow, Izdatel'stvo Transport, 1983, 256 p. In Russian. refs

This handbook contains information regarding the major documents which are concerned with the operation and the repair of the ground-based equipment of airports and airways, the standard specifications regarding the fitness of the equipment for operation, and the characteristics of the equipment. Questions regarding the organization of repair operations are examined along with the employed equipment. The basic regulations concerning the certification of airports and airways in the USSR are described, taking into account also the utilized equipment. The radar equipment is considered along with the ground-based equipment of radio beacon landing systems, the ground-based equipment of radio systems and installations for short-range navigation, automatic air traffic control (ATC) systems, and equipment for the display and the documentation of information. Attention is given to equipment for maintaining communication with aircraft, meteorological installations, the organization of the technical operation of the equipment for navigation and ATC, and the reliability of this equipment. G.R.

A84-41330* Washington Univ., Seattle.

NUMERICAL SIMULATION OF CONTROLLED FLOW TUNNEL FOR V/STOL TESTING

R. G. JOPPA (Washington, University, Seattle, WA) and P. C. PARIKH American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, 2nd, Seattle, WA, Aug. 21-23, 1984. 10 p. refs

(Contract NSG-2260)
(AIAA PAPER 84-2152)

A 'smart' wind tunnel concept for V/STOL transition regime studies is presented and performance is projected with numerical simulations. The wind tunnel would provide a flow that faithfully represents free air flow and thereby permits accurate lift calculations for V/STOL aircraft. The design concept is based on free-air tunnels used for planar wings. Modifications are necessary to account for the highly deflected, vortical wake produced in low-speed take-off and landing situations. A three-step numerical procedure covering the potential flow of a high lift system in free-air, controlled flow data with a model in a wind tunnel and addition of the wall conditions to the simulation as a feedback loop to correct the closed-tunnel is described. The initial simulation is for

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three-dimensional full span jet flapped wings, and is derived from extended two-dimensional calculations. The results indicate that only partial control of the tunnel flow is sufficient to serve as a valid environment for V/STOL studies. M.S.K.

A84-42352#

CONSIDERATIONS IN THE USE OF IN-FLIGHT AND GROUND BASED SIMULATION

S. R. MARKMAN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 258-264.

(AIAA PAPER 84-2102)

Ground-based flight simulation addresses a wide variety of technical issues in a safe environment, at reasonable cost and in a timely manner, but its results are often limited with respect to the fidelity of motion and visual clues presented to the pilot. In-flight simulation, which does not suffer from these shortcomings, is limited by the capabilities of the aircraft on which the simulation system is based. Attention is presently given to the tradeoffs which must be considered in choosing between these two simulation methods, with emphasis on human pilot interaction. O.C.

A84-42355#

DIRECT DERIVATIVE MEASUREMENTS IN THE PRESENCE OF STING PLUNGING

M. E. BEYERS (National Aeronautical Establishment, Unsteady Aerodynamics Laboratory, Ottawa, Canada) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 294-301. refs

(AIAA PAPER 84-2107)

This paper presents a review and extension of methods for determining the effects of sting oscillation on the measurement of dynamic derivatives due to oscillatory pitching. It is shown that two of the methods based on linear models will reduce to the same result, applicable to low-lift configurations. The location of the effective axis of rotation is determined for a model executing planar oscillations in two degrees of freedom. The equations for the effect of plunging on the derivatives can be simplified by relating the sting deflection parameters to the coordinate of this axis. The implications for analysis of sting plunging oscillation in dynamic tests of aircraft models at high angles of attack are also discussed. The effective rotation center could be determined by a simple method, and the associated effects evaluated, in pitch-oscillation tests of the Standard Dynamics Model at angles up to 45 deg. The axis shift was found to produce the main effect on the measured data. Author

A84-42573

ATMOS - SIMULATION FOR THE AIR TRAFFIC OF TOMORROW [ATMOS - SIMULATION FUER DEN LUFTVERKEHR VON MORGEN]

J. THOMAS (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Flugfuehrung, Brunswick, West Germany) DFVLR-Nachrichten (ISSN 0011-4901), vol. 42, June 1984, p. 32-36. In German.

New developments lead to changes in the air traffic control systems of today. Trends are related to the aim of an optimization of traffic operations mainly with respect to economical considerations. The utilization of computers in flight planning and management on board and on the ground is leading to the intensified automation of functions formerly performed by people. Studies are being conducted concerning the optimal distribution of functions between man (pilot, controller) and computer-aided control systems. Research related to the development and the design of computational aids for the controller is also performed. Possible approaches for solving the involved problems have to be tested. This is done with the aid of ATMOS (Air Traffic Management and Operations Simulator). Attention is given to the ATMOS system concept, the simulation of air traffic, the representation of air traffic,

resimulation and traffic analysis, and current and future tasks regarding the simulation of the aircraft in air traffic. G.R.

N84-28812# Federal Aviation Agency, Atlantic City, N.J.

IDENTIFICATION OF EXIT TAXIWAYS (RETROFLECTIVE MARKERS ONLY) Final Report, Mar. 1981 - Oct. 1982

L. W. HACKLER Apr. 1983 35 p refs

(FAA-CT-83-5; FAA-RD-82-91) Avail: NTIS HC A03/MF A01

The purpose of the exit taxiway lighting is to enable the pilot to expeditiously exit from the runway to a taxiway. There is evidence that this was not satisfactorily accomplished by the present lighting for short-radius exit taxiways. The use of surface retroreflective markers for identifying short-radius exit taxiways at night was evaluated. The markers are intended for locations where the cost of inset centerline lighting cannot be justified. The results indicate that there was an improvement in the pilots ability to identify the exit taxiway associated with the exit-taxiway retroreflectors. The results also show that the retroreflectors should be placed on an arc from near the runway centerline to the taxiway centerline using a cord spacing of 12.5 feet (4 meters). Author

N84-28813# National Aerospace Lab., Tokyo (Japan).

NATIONAL AEROSPACE LABORATORY, 1982

1982 28 p refs In JAPANESE

Avail: NTIS HC A03/MF A01

The National Aerospace Laboratory (NAL) of Japan is described. Topics include facility history, organization, operating budget, research projects, and research facilities. Emphasis is placed on low noise, fan jet STOL aircraft, liquid oxygen and hydrogen rocket engines, high pressure liquid fuel turbopump systems, gas turbine engine design, and satellite remote sensing research. M.A.C.

N84-28814*# National Aeronautics and Space Administration, Washington, D. C.

THE F2 WIND TUNNEL AT FAUGA-MAUZAC

D. AFCHAIN, P. BROUSSAUD, M. FRUGIER, and G. RANCARANI May 1984 39 p refs Transl. into ENGLISH of "La Soufflerie F2 du Centre du Faua-Mauzac" rept. ONERA-TP-1983-139 ONERA, Chatillon, France, 1983 p 1-29 Presented at the 20th Colloq. d'Aerodyn. Appl., Toulouse, 8-10 Nov. 1983 Original language document was announced as A84-19928

(Contract NASW-3541)

(NASA-TM-77482; NAS 1.15:77482) Avail: NTIS HC A03/MF A01 CSCL 14B

Details on the French subsonic wind-tunnel F2 that becomes operational on July 1983 are presented. Some of the requirements were: (1) installation of models on any wall of the facility, (2) good observation points due to transparent walls, (3) smooth flow, (4) a laser velocimeter, and (5) easy access and handling. The characteristics include a nonpressurized return circuit, dimensions of 5 x 1.4 x 1.8 m, maximum velocity of 100 m/s and a variable speed fan of 683 kW. Author (IAA)

N84-28815# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.

THE PERFORMANCE OF CIVIL AIRPORT PAVEMENT WITH LIME-CEMENT-FLYASH BASE COURSE Final Report

A. L. MCLAUGHLIN Apr. 1984 23 p refs

(FAA-PM-84-10) Avail: NTIS HC A02/MF A01

The background and application of lime, cement and flyash are reviewed in order to explain the performance of civil aviation airport pavements constructed with lime-cement-flyash as a base course. The report states that performance of these pavements has been good and that the state of the art presently provides experimental techniques and laboratory tests to assure an economical and safe design. It is observed that many of the problems are associated with environmental forces and long-term behavior of the materials. A recommendation is that long-term performance together with the effectiveness of any remedial measures should be systematically monitored and catalogued so that any needed changes in the technology can be identified. Also, construction procedures and specifications limits can now

be provided to the airport pavement engineering community on the basis of existing data and additional laboratory investigations.

Author

N84-28816# Navy Experimental Diving Unit, Panama City, Fla.
EVALUATION OF A CARBON DIOXIDE SCRUBBER IN A 2-LOCK RECOMPRESSION CHAMBER Final Report
 H. J. C. SCHWARTZ, P. H. ROBINSON, D. K. SCHRAM, and A. J. SARICH Mar. 1984 23 p
 (AD-A141052; NEDU-6-84) Avail: NTIS HC A02/MF A01 CSCL 06K

An unmanned study of a carbon dioxide scrubber in a standard U.S. Navy two-lock recompression chamber is presented. Tests were conducted at the Navy Experimental Diving Unit to determine canister air flows and durations at various depths and initial carbon dioxide concentrations, using a Kinergetics, Incorporated Scrubber, Model DH-10. Air flows were 262 LPM, 274 LPM, and 270 LPM, at 15 FSW, 30 FSW, and 60 FSW respectively. For the canister duration studies an initial load of carbon dioxide was introduced into the chamber, then carbon dioxide was added to the chamber at a rate of 2 standard liters per minute to simulate 3 human occupants. Canister durations under steady state conditions of a long treatment were estimated to be 3.46 hours at 30 FSW, 1.89 hours at 60 FSW, and 1.16 hours at 165 FSW. Author (GRA)

N84-28817# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

RESPONSE AND PERFORMANCE OF CONTINGENCY AIRFIELD PAVEMENTS CONTAINING STABILIZED MATERIAL LAYERS Ph.D. Thesis

R. R. COSTIGAN Apr. 1984 269 p
 (AD-A141466; AFIT/CI/NR-84-9D) Avail: NTIS HC A12/MF A01 CSCL 13B

The purpose of this study was to validate the mechanistic approach for the design and evaluation of Contingency Airfield Pavements (CAPs) containing stabilized material layers. The mechanistic approach was validated by relating predicting first pass structural response parameters (stress and strain) to observed performance of field test items. Major study findings included: (1) Subgrade characteristics control performance in pavements with predicted first pass crack stress ratio greater than one, (2) CAPs should be designed and evaluating using an intact slab concept, (3) Design of CAPs should be based on stress or strain ratios less than one, (4) The presence of a crushed stone base course over a stabilized subbase course in an inverted pavement has a bridging effect at transfer cracks in the stabilized subbase and inhibits the rate of crack propagation to the surface. GRA

N84-28818# Florida State Univ., Gainesville. Dept. of Civil Engineering.

CENTRIFUGAL SCALING LAWS FOR GROUND LAUNCH CRUISE MISSILE SHELTER Final Report, 1 Jul. - 31 Dec. 1983

D. M. BRADLEY, F. C. TOWNSEND, F. E. FAGUNDO, and J. L. DAVIDSON Apr. 1984 95 p
 (Contract F08635-83-C-0136; AF PROJ. 2673)
 (AD-A141572; AFESC/ESL-TR-84-07) Avail: NTIS HC A05/MF A01 CSCL 13M

This report summarizes the feasibility of, and scaling relationships for, centrifugal modelling of the GLCM shelter. Similitude between model and prototype is deemed possible if constitutively similar reinforced concrete and soil are used in the model. However, currently available US centrifuges limit GLCM shelter model scales to 1/150 to 1/300, which causes difficulties in model construction with microconcrete and miniaturized reinforcement. Therefore, centrifugal modelling of GLCM components, coupled with computer analyses, is recommended.

Author (GRA)

N84-28819# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

BOMB DAMAGE REPAIR: PRECAST SLAB DESIGN Final Technical Report, Oct. 1981 - Mar. 1983

W. N. BRABSTON Apr. 1984 124 p
 (Contract MIRP-N-82-40; AF PROJ. 2612)
 (AD-A141687; AFESC/ESL-TR-84-21) Avail: NTIS HC A06/MF A01 CSCL 01E

A study was made to evaluate various methods of rapid repair of bomb craters on runways using precast concrete slabs as structural elements. Primary focus was on optimum utilization of the concrete slabs when placed on debris backfill and on compacted select material backfill. Three primary repair concepts were studied: placement of slabs flush with the surrounding pavement and interlocked at the edges with concrete grout (Flush Slab Method); placement of slabs slightly below the surrounding pavement and surfaced with a 2-inch thick concrete cap screeded flush with the old pavement (Submerged Slab Method); and placement of the slab flush with the old pavement with no-load transfer mechanism (German Method). Analyses were made of the various repair methods based on estimated time of repair and on expected structural response under aircraft loading. Time estimates were subdivided into time elements for the major repair tasks. Structural analyses were conducted with layered elastic and modified finite element computer codes. Repair methods evaluated as having most potential for development as standard procedures were those involving use of slabs submerged in a capped-concrete matrix. Analyses indicated that the other two methods offered less potential for future development. It was recommended that field tests be conducted to further evaluate all three methods.

Author (GRA)

N84-28820# School of Aerospace Medicine, Brooks AFB, Tex.
HYPERBARIC CHAMBER EQUIPMENT: A CONSOLIDATED EQUIPMENT LIST FROM SELECTED MULTIPLACE HYPERBARIC FACILITIES Final Report, 10 Oct. 1982 - 15 May 1983

P. J. SHEFFIELD and S. E. PIWINSKI Dec. 1983 25 p
 (Contract AF PROJ. HM88)
 (AD-A141702; USAFSAM-TR-83-34) Avail: NTIS HC A02/MF A01 CSCL 14B

The objective of this report is to provide a list of equipment applicable to clinical hyperbaric chambers. Information from this document would be used in planning the equipment required for future clinical facilities. Twenty-two responses from multiplace clinical hyperbaric facilities in the United States and Canada provided the information contained in this consolidated list of chamber monitoring and ancillary support equipment and medical support equipment. Chamber monitoring and ancillary equipment included gas/vapor monitoring equipment, carbon dioxide scrubbers, air conditioning, communications, lighting, and fire detecting and fire extinguishing systems. Medical support equipment was limited to patient monitoring equipment, automatic ventilators, and chamber cleaning/sterilization. Some items must be adapted with special devices (such as nitrogen purging) in order to be used in hyperbaric environment. Wherever possible, the source of equipment (manufacturer and address) is provided.

GRA

N84-28821# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.

STUDIES OF US UNIVERSITIES' RESEARCH EQUIPMENT NEEDS INCONCLUSIVE

3 Apr. 1984 23 p
 (AD-A141784; AD-E750818; GAO/RCED-84-105) Avail: NTIS HC A02/MF A01 CSCL 14B

In 1982, various scientific leaders estimated that the cost to update university research equipment was between \$1 billion and \$4 billion. Because of this large cost variance, GAO was requested to assess how well past studies have defined the nationwide deficiency in university research equipment and to suggest what other work is needed to better determine equipment needs. GAO examined five completed studies that described the status of

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university equipment needs and two such studies which are still in progress. Although each completed study stated that universities have had a substantial need for equipment, none of these studies can be used to determine current needs. This report analyzes studies and other relevant data to determine the causes and factors which influence universities' need for research equipment and identify and evaluate options for equipping university laboratories.

GRA

N84-28822# Naval Postgraduate School, Monterey, Calif.
PROPOSAL AND DEVELOPMENT PLAN FOR AN AIRCRAFT SYSTEMS INTEGRATION LABORATORY M.S. Thesis

R. W. ILLER Dec. 1983 52 p
(AD-A141827) Avail: NTIS HC A04/MF A01 CSCL 01C

This paper presents a proposal and a plan for the development of an aircraft systems integration laboratory (ASIL) in the Department of Aeronautics at the Naval Postgraduate School. The paper addresses the current and future benefits of and requirements for the laboratory in the areas of research and education, describes the capabilities of the proposed laboratory, presents a plan for its development, details the costs involved, and outlines the support required for construction and operation. The purpose of the laboratory will be to conduct research in the man machine interface problems with aerospace systems and to facilitate the education of Naval aviation officers in the complexities of modern aircraft systems integration.

GRA

N84-29665*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

A COMPARISON OF WIND TUNNELS SUITABLE FOR ROTORCRAFT NOISE STUDIES

P. T. SODERMAN /n NASA. Langley Research Center Rotorcraft Noise p 45-62 Jul. 1982
Avail: NTIS HC A18/MF A01 CSCL 14B

Many good small scale facilities are available for rotorcraft noise research. Ames 40 x 80/80 x 120 probably is a good large scale facility for acoustic research of large or small rotorcraft, but the acoustic quality of the modified facility was not yet measured. DNW is probably the best aeroacoustic facility, but may be expensive. Other parameters to consider besides background noise are turbulent level and scale, restricted measurement field, local reflections, and speed range. Advanced measurement techniques improve data quality from any facility.

B.G.

N84-29887 British Aerospace Aircraft Group, Warton (England).
Wind Tunnel Dept.

WALL PRESSURE SIGNATURE WIND-TUNNEL WALL-CONSTRAINT CORRECTION METHODS

J. G. PROCTOR Apr. 1984 42 p refs
(BAE-ARG-188) Avail: Issuing Activity

Three methods of wall-constraint correction using boundary measurements of static pressure are assessed. The procedures offer an alternative to conventional theoretical techniques in areas of relative uncertainty such as very high incidence testing. It is recommended that a short test program to study the practicalities of an on-line matrix method be implemented in a 2.7 x 2.1m low speed wind tunnel.

Author (ESA)

N84-29888*# Madison Magnetics, Inc., Wis.
MAGNETIC SUSPENSION AND BALANCE SYSTEM STUDY Final Report, Jun. 1983 - Mar. 1984

R. W. BOOM, Y. M. EYSSA, G. E. MCINTOSH, and M. K. ABDELSALAM Washington NASA Jul. 1984 118 p
(Contract NAS1-17428)
(NASA-CR-3802; NAS 1.26:3802) Avail: NTIS HC A06/MF A01 CSCL 14B

A compact design for a superconducting magnetic suspension and balance system is developed for a 8 ft. x 8 ft. transonic wind tunnel. The main features of the design are: a compact superconducting solenoid in the suspended airplane model; permanent magnet wings; one common liquid helium dewar for all superconducting coils; efficient new race track coils for roll torques; use of established 11 kA cryostable AC conductor; acceptable

AC losses during 10 Hz control even with all steel structure; and a 560 liter/hour helium liquefier. Considerable design simplicity, reduced magnet weights, and reduced heat leak results from using one common dewar which eliminates most heavy steel structure between coils and the suspended model. Operational availability is thought to approach 100% for such magnet systems. The weight and cost of the magnet system is approximately one-third that of previous less compact designs.

Author

N84-29889# Federal Aviation Administration, Washington, D.C.
Associate Administrator for Airports.

REPORT OF ACCOMPLISHMENTS UNDER THE AIRPORT IMPROVEMENT PROGRAM Annual Report, period ending 30 Sep. 1983

V. J. MARTIN 30 Sep. 1983 112 p
(AD-A142444; FAA-ARP-84-2; AR-2) Avail: NTIS HC A06/MF A01 CSCL 01E

Section 521 of the Airport and Airway Improvement Act of 1982 (Public Law 97-248) requires that the Secretary of Transportation submit an annual report to Congress describing the accomplishments of the airport grant program. This report covers activities for the fiscal year ending September 30, 1983.

Author (GRA)

N84-29890# European Space Agency, Paris (France).
THE TECHNICAL UNIVERSITY OF DENMARK (TUD)-ESA SPHERICAL NEAR FIELD ANTENNA TEST FACILITY, LYNGBY, DENMARK

J. E. HANSEN Apr. 1984 22 p refs Original contains color illustrations
(ESA-BR-19; ISSN-0250-1589) Avail: NTIS HC A02/MF A01; ESA, Paris FF 60 Member States, AU, CN and NO (+20% others)

A radio anechoic chamber for the determination of antenna characteristics and the measurement of scattering cross-sections of radar targets in the frequency range 50 MHz to 50 GHz is presented. It is 12 m long, 10 m wide and 8 m high (measured between the tips of absorbers). The chamber and control room are enclosed in RF shielding. Activities include precision gain calibration of standard-gain horns; maintenance of sets of calibrated standard-gain horns which are available on a loan basis to ESA projects; calibration of near-field probes; precision measurement of gain, directivity, phase, co-polar and cross-polar patterns for microwave antennas with diameters of up to 6.7 m; and research on measurement techniques.

Author (ESA)

N84-29891# National Aerospace Lab., Amsterdam (Netherlands).
Fluid Dynamics Div.

HALF-MODEL TESTING IN THE NLR HIGH SPEED WIND TUNNEL (HST) Status Report, 1981

S. J. BOERSEN Aug. 1982 76 p refs
(NLR-TR-82123-U) Avail: NTIS HC A05/MF A01

The reliability of half-span model testing in a high speed tunnel is discussed. Comparison with full-span model results shows that tests on large half-span models suffer from significant mounting and wall interference effects; the usual full-span model test accuracy cannot be achieved. A mounting using a non-metered boundary layer and labyrinth seal is recommended. Contact between metered and non-metered parts must be avoided. Corrections for half-span model test results were derived from fuselage-only and wing-fuselage comparisons of half-span and full-span models. Wing deformation should be accounted for. Tunnel blockage corrections were deduced from a comparison of average wing pressure distributions of half-span and full-span wings.

Author (ESA)

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A84-40601**SPACE - THE NEXT TWENTY YEARS; PROCEEDINGS OF THE TWENTIETH SPACE CONGRESS, COCOA BEACH, FL, APRIL 26-28, 1983**

Congress sponsored by the Canaveral Council of Technical Societies. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1984, 426 p.

The subjects discussed are related to private enterprise in space, computers and simulators, orbital operations, energy applications in space, STS cargos, future space transportation systems, and a space station. The presence of diamagnetic oxygen in space is considered along with X-ray examination of possible QSO models, the operation of the solar powered Stirling engine in space, cancer observation in zero G, the effects of zero-gravity environment on the crossing over mechanism of yeast chromosomes, planaria regeneration in zero-gravity, the design of microgravity space environments to enhance crew health and productivity, artificial intelligence and man in space, risk and investment decisions, and computer graphics. Attention is given to a comparison of manned and unmanned orbital construction and maintenance, a laboratory in space, biomedical requirements for space cabin environment, hydrogen from renewable energy, and alternative liquid fuels for transportation. G.R.

A84-40604* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE SHUTTLE MISSION SIMULATOR COMPUTER GENERATED IMAGERY

T. H. HENDERSON (NASA, Johnson Space Center, Flight Simulation Div., Houston, TX) IN: Space - The next twenty years; Proceedings of the Twentieth Space Congress, Cocoa Beach, FL, April 26-28, 1983. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1984, p. IB-24 to IB-36.

Equipment available in the primary training facility for the Space Transportation System (STS) flight crews includes the Fixed Base Simulator, the Motion Base Simulator, the Spacelab Simulator, and the Guidance and Navigation Simulator. The Shuttle Mission Simulator (SMS) consists of the Fixed Base Simulator and the Motion Base Simulator. The SMS utilizes four visual Computer Generated Image (CGI) systems. The Motion Base Simulator has a forward crew station with six-degrees of freedom motion simulation. Operation of the Spacelab Simulator is planned for the spring of 1983. The Guidance and Navigation Simulator went into operation in 1982. Aspects of orbital visual simulation are discussed, taking into account the earth scene, payload simulation, the generation and display of 1079 stars, the simulation of sun glare, and Reaction Control System jet firing plumes. Attention is also given to landing site visual simulation, and night launch and landing simulation. G.R.

A84-42386* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

VELOCITY ESTIMATION ON A DUAL-SPIN SPACECRAFT

D. BOUSSALIS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Annual Pittsburgh Conference, 13th, Pittsburgh, PA, April 22, 23, 1982, Proceedings. Part 1. Research Triangle Park, NC, Instrument Society of America, 1982, p. 105-109.

(Contract NAS7-100)

The problem of estimating the changes in velocity during the various dV maneuvers of a dual-spin spacecraft is examined. A

N84-29892# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

DESCRIPTION AND VALIDATION OF THE TWO DIMENSIONAL TEST SETUP FOR MULTIPLE AIRFOILS IN THE PRESSURIZED WIND TUNNEL HST

H. L. J. VOGELAAR 18 Mar. 1983 36 p refs
(NLR-TR-83031-U) Avail: NTIS HC A03/MF A01

The two-dimensional test setup in a pressurized wind tunnel (HST) for the testing of multiple airfoils at high Reynolds numbers is described. Results of tests with this setup were validated by tests performed in the HST and in an atmospheric wind tunnel. The tunnel wall boundary layer control system and the tunnel wall correction method are outlined. Results of model deformation tests are discussed. Author (ESA)

N84-29893# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.

FEDERAL AVIATION ADMINISTRATION'S SYSTEM FOR PRIORITIZING AIRPORT GRANTS

13 Apr. 1984 20 p
(PB84-181650; GAO/RCED-84-124; B-214677) Avail: NTIS HC A02/MF A01 CSCL 01E

The Federal Aviation Administration's (FAA's) system for prioritizing discretionary airport grant projects is reviewed. The airports named in 1982 and 1983 congressional appropriation reports examined to determine if naming airports for priority consideration causes the FAA to fund low priority projects. Airport planning and development projects in four FAA regions during fiscal years 1982 and 1983 analyzed to determine: (1) if FAA funded the projects in conformance with its priority system, and (2) the basis for funding projects that ranked low under the system. GRA

N84-29894 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

A SURVEY OF BIODYNAMIC TEST DEVICES AND METHODS

N. S. NUSSBAUM (Aerospace Medical Research Lab.) Apr. 1984 58 p refs
(AD-A142467; AGARD-AG-276) Avail: NTIS HC A04/MF A01 CSCL 06S

The author has up-dated AGARD Report No. 658 "A Catalogue of Current Impact Devices" to include new/revised facilities, has presented research procedures in use at each facility and described the personnel capabilities available. The information about each facility has been obtained largely from inputs completed by the establishments concerned, technical reports, previous listings and personal visits. Author

N84-29964# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.

AERODYNAMIC AND PROPULSION TEST UNIT (APTU) PERFORMANCE WITH A VITIATED AIR HEATER

R. H. BURT, D. W. STALLINGS, and M. SWILLUM (AEDC) IN: APL The 1984 JANNAF Propulsion Meeting, Vol. 2 p 261-270
Feb. 1984 refs

Avail: NTIS HC A15/MF A01 CSCL 14B

The Aerodynamic and Propulsion Test Unit (APTU) at Arnold Engineering Development Center, Arnold AFS, Tennessee, has been equipped with a newly installed vitiated, or instream combustion, air heater (VAH). The facility operates in the blowdown mode, and the VAH supplies the enthalpy required to match atmospheric temperatures over a wide range of Mach numbers and altitudes. Initial shakedown tests and a rocket/ramjet test program have been completed. Complete descriptions of the facility and subsystems are included along with typical results from the shakedown tests demonstrating present capabilities of the facility. The test results include gas-sampling measurements of the vitiated test medium and show the unique capabilities of the completely computer-controlled facility. This capability is particularly important since a renewed interest in ramjets is at hand, and further utility of the facility is being planned for materials evaluation and other aerothermodynamic testing. Planned improvements of the facility are also discussed. Author

10 ASTRONAUTICS

concise estimator suitable for on-board computer implementation is then developed to provide dV estimates based on the measurements obtained from two asymmetrically mounted accelerometers. Author

N84-28837# Joint Publications Research Service, Arlington, Va.
NIGHT LANDING OF 'SOYUZ-23' COSMONAUTS IN LAKE TENGIZ RECOUNTED

G. BOCHAROV *In its* USSR Rept.: Space (JPRS-USP-84-003) p 49-56 14 Jun. 1984 Transl. into ENGLISH from Lit. Gaz. (USSR), 25 Jan. 1984 p 10
Avail: NTIS HC A07

Upon failure to dock with Salyut-7, the Soyuz-23 returned to earth. The difficulties encountered and the final recovery of the spacecraft are described. B.G.

N84-28886# Range Commanders Council, White Sands Missile Range, N. Mex. Documentation Group.

UNIVERSAL DOCUMENTATION SYSTEM HANDBOOK. SUPPLEMENT 2: PROCEDURES FOR THE ELECTRONIC PROCESSING OF LEVEL 1, 2 AND 3 TEST REQUIREMENTS AND SUPPORT INFORMATION

May 1984 54 p Supersedes DG-501-79-SUPPL-2, AD-A108901
(AD-A141850; DG-501-84-SUPPL-2; DG-501-79-SUPPL-2) Avail: NTIS HC A04/MF A01 CSCL 09B

This supplement describes the procedures for converting the Universal Documentation System (UDS) horizontal forms to a vertical format more conducive to electronic transmission. This system may be used in conjunction with UDS documents using standard UDS forms or in place of the standard format when automation or electronic processing of UDS documents is desired. The Universal Documentation System Handbook, Document 501-79, Volumes 1, 2, and 3, dated 11-79, (AD-108901) should be used for detailed instructions. These procedures do not address the electronic transmission of classified information. GRA

N84-28887*# Goodyear Aerospace Corp., Akron, Ohio.
SYSTEM DEFINITION STUDY OF DEPLOYABLE, NON-METALLIC SPACE STRUCTURES

F. J. STIMLER Jun. 1984 156 p refs
(Contract NAS8-35498)
(NASA-CR-171090; NAS 1.26:171090; GAC-19-1615) Avail: NTIS HC A08/MF A01 CSCL 22B

The state of the art for nonmetallic materials and fabrication techniques suitable for future space structures are summarized. Typical subsystems and systems of interest to the space community that are reviewed include: (1) inflatable/rigidized space hanger; (2) flexible/storable acoustic barrier; (3) deployable fabric bulkhead in a space habitat; (4) extendible tunnel for soft docking; (5) deployable space recovery/re-entry systems for personnel or materials; (6) a manned habitat for a space station; (7) storage enclosures external to the space station habitat; (8) attachable work stations; and (9) safe haven structures. Performance parameters examined include micrometeoroid protection; leakage rate prediction and control; rigidization of flexible structures in the space environment; flammability and offgassing; lifetime for nonmetallic materials; crack propagation prevention; and the effects of atomic oxygen and space debris. An expandable airlock for shuttle flight experiments and potential tethered experiments from shuttle are discussed. A.R.H.

N84-28890# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.

WIND TUNNEL MATERIAL TEST TO QUANTIFY SPACE SHUTTLE EXTERNAL TANK INSULATION REQUIREMENTS
Final Report, 26 - 28 Jul. 1983

A. S. HARTMAN AEDC Sep. 1983 37 p Sponsored by AEDC
(AD-A141563) Avail: NTIS HC A03/MF A01 CSCL 13A

The objective of this test was to determine the response of the thermal protection material used in the press line bracket/cable tray region of the Space Shuttle External Tank (ET) to an

aerothermal environment. Foam insulation specimens were mounted on a concave plate which was injected to the edge of the wind tunnel nozzle. This allowed the nozzle boundary layer to flow onto the specimen plate. Thus, the turbulent boundary layer approaching the specimen region was significantly thicker than could be produced by other more standard test methods. Data from this test will be used to evaluate a possible reduction in weight of the Space Shuttle External Tank by reducing the amount of insulative material or replacing it with a lighter material. GRA

N84-28896# California Univ., Berkeley. Electronics Research Lab.

AN INTEGRATED, OPTIMIZATION-BASED APPROACH TO THE DESIGN AND CONTROL OF LARGE SPACE STRUCTURES
Annual Scientific Report, 1 Oct. 1983 - 1 May 1984

E. POLAK, K. S. PISTER, and R. L. TAYLOR 1 May 1984 21 p

(Contract AF-AFOSR-0361-83; AF PROJ. 2304)

(AD-A141856; AFOSR-84-0448TR) Avail: NTIS HC A02/MF A01 CSCL 12A

The investigators proposed to consider the design of large space structures which are required to perform large amplitude maneuvers at the end of which they are required to remain locked on a target. They proposed to deal with the pointing of the LSS in two stages. In the first stage, the control task is to rapidly redirect the pointing direction of the LSS reference axis, e.g., the line-of-sight of a telescope or antenna, by open loop optimal control, the large motions of the LSS induced by the maneuver must quiet down so that the control of the LSS can be transferred to a linear, closed loop control system. The task of the latter is to damp out the induced structural vibrations, and, finally, to lock the pointing direction on the target. For the purpose of obtaining a tractable model problem for the research, the investigators shall initially assume that the LSS is a beam. The investigators shall use a nonlinear beam model for the large motions, and they shall use a linear beam model to describe the small displacements as a perturbation around the equilibrium rigid body configuration. In fully developing the model problem, described within the investigators shall first develop the equations of motion for a beam under large and small displacement conditions. They shall then use the resulting equations in transcribing sample design specifications into infinite systems of inequalities. Author (GRA)

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A84-40052#

AN ASSESSMENT OF CORRELATIONS BETWEEN LABORATORY AND FULL-SCALE EXPERIMENTS FOR THE FAA AIRCRAFT FIRE SAFETY PROGRAM. I - SMOKE

J. G. QUINTIERE (National Bureau of Standards, Washington, DC) IN: Progress in fire safety - Regulations, polymers, chemicals, markets; Proceedings of the Joint Meeting, San Antonio, TX, March 16-18, 1982. Part 1. Lancaster, PA, Technomic Publishing Co., Inc., 1984, p. 35-85. FAA-sponsored research. refs

An extensive review is presented demonstrating the nature of comparison between full-scale fire smoke data and test method results for materials. These correlations are presented in terms of consistent parameters established through a development of the governing equations for smoke concentration and light attenuation. Visibility data limited to light transmission through smoke are also presented. The complex dependence of smoke production on many parameters acting in fire growth limits the success of simple correlation methods. Recommendations are made for further

research to establish a sound basis for correlations, and the prediction of smoke obscuration due to fire. Author

A84-40250

EFFECTS OF TEMPERATURE AND PRESSURE ON THE PHOTOCHEMICAL REACTIVITY OF A REPRESENTATIVE AVIATION FUEL

W. P. L. CARTER, R. ATKINSON, and A. M. WINER (California, University, Riverside, CA) Environmental Science and Technology (ISSN 0013-936X), vol. 18, July 1984, p. 556-561. refs (Contract F08635-80-C-0389)

Environmental chamber tests were performed to examine the photochemical activities of military JP-4 fuel in the presence of NO(x)-contaminated air. The solar irradiations were produced with a 25 kW lamp at 0 and 70 deg zenith angles. The tests simulated the photochemical processes undergone by jettisoned fuel at ground-level, 10,000 and 20,000 ft altitudes at various temperatures and pressures. Ozone yield decreased with altitude or decreasing temperatures and NO oxidation rates decreased with decreasing pressure. The results indicate that NO oxidation rates will increase with altitude in the open atmosphere. M.S.K.

A84-40374

COMPOSITE MATERIALS RESPONSE UNDER LOW-VELOCITY IMPACT

G. CAPRINO, I. CRIVELLI VISCONTI, and A. DI ILIO (Napoli, Università, Naples, Italy) Composite Structures (ISSN 0263-8223), vol. 2, no. 3, 1984, p. 261-271.

Mode predictions and data were compared for the low-velocity impact strength of three composites: glass cloth-polyester (GP), carbon cloth-polyester (CP) and nylon cloth-polyester (NP). The low-velocity impacts are expected in aerospace applications from events like dropping tools. An energy method was used to predict the composites' dynamic behavior in terms of elastic and post-elastic fields. Weights were dropped on flat specimen plates clamped on two free edges. Force-displacement curves were predicted and measured for the samples. The behaviors of CP and NP were not strongly affected by the loading range or at the impact speeds examined. GP was significantly affected by the loading rate. The energy model predictions were well-matched by the data, implying that static tests should be sufficient for determining the low-velocity impact strength of composites. M.S.K.

A84-40613

FUELS OF THE FUTURE

A. M. MOMENTHY (Boeing Commercial Airplane Co., Seattle, WA) IN: Space - The next twenty years; Proceedings of the Twentieth Space Congress, Cocoa Beach, FL, April 26-28, 1983. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1984, p. IIA-31 to IIA-46. refs

A number of technology readiness evaluations and future prospects speculations are made for aviation fuels, in view of the development effort required for the various alternatives and the economic viability of their products in the coming decades. Attention is also given to the thermodynamic, operational, and aircraft design-related advantages and disadvantages of the fuels in question. The fuels are conventional aviation gasoline and jet engine kerosene derived synthetically from oil sands, coal, and oil shale; cryogenic fuels such as liquid hydrogen and methane, which would call for major changes in aircraft configurations due to their large storage volumes; and more speculatively, such long-term alternative energy sources as small, lightweight fusion reactors, electrochemical cells, spacecraft-reflected sunlight, and off-peak electricity stored as inertial energy in flywheels. O.C.

A84-40791

LIGHTER ALUMINUM ALLOY DEVELOPMENT PROGRESSES

D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 4, July-August 1984, p. 15-18.

Attention is given to the results of a study in which the relationship between weight savings and mechanical property improvements, in the aluminum-lithium alloys being developed to

replace the current 2024 and 7075 aluminum alloys, were assessed. The aluminum-lithium alloy with properties similar to 2024 has 7 percent lower density, and will be primarily used in tension-loaded structures. The alloy intended as a replacement for 7075 has 8 percent lower density, and is to be used in compression-loaded structures whose fatigue strength is of primary importance. O.C.

A84-40913#

EFFECT OF ADVERSE ENVIRONMENT ON COMPOSITES

R. L. RAMKUMAR (Northrop Corp., Structural Mechanics Research Dept., Hawthorne, CA) IN: Joint Conference on Experimental Mechanics, Oahu and Maui, HI, May 23-28, 1982, Proceedings. Part 1. Brookfield Center, CT, Society for Experimental Stress Analysis, 1984, p. 110-117. (Contract F33615-79-C-3203)

The effect of simulated adverse environments on the structural integrity of graphite/epoxy laminates was investigated through an experimental program. Test specimens were preconditioned to simulate repeated combat missions of an advanced supersonic fighter aircraft operating from a humid air base. Residual strength compression strengths were measured to quantify the effects of adverse environmental exposures. The moisture profiles in the thickness direction of the specimens exposed to the various environments were obtained by slicing plies, under a microtome, and measuring the moisture content at the lamina level. The effect of moisture on the glass transition temperature (Tg) was measured using a heat distortion technique. Critical environmental parameters were identified through an analysis of the generated residual strength data, in conjunction with the moisture profiles and the Tg data. Author

A84-41854

OFF-OPTIMUM CURE CONDITIONS FOR STRUCTURAL ADHESIVES - SOME EFFECTS ON PERFORMANCE

S. A. MESTAN, F. C. TOLAN, and C. E. M. MORRIS (Department of Defence, Materials Research Laboratories, Ascot, Victoria, Australia) SAMPE Quarterly (ISSN 0036-0821), vol. 15, July 1984, p. 18-24. refs

The effect of the use of low temperature and pressure on the tensile-shear strength of lap joints and on the dynamic mechanical properties of the adhesive has been examined for three epoxy-based, film adhesives with recommended curing temperatures around 177 C. Low cure temperature was found to have a more serious effect than low pressure while the use of vacuum bagging procedures at low temperatures gave lap joints of the least satisfactory performance. Author

A84-42209

FIBRE/RESIN COMPOSITES FOR AIRCRAFT PRIMARY STRUCTURES - A SHORT HISTORY, 1936-1984

P. MCMULLEN Composites (ISSN 0010-4361), vol. 15, July 1984, p. 222-230. refs

The origins of composite materials, in the widest definition of this term, occurred long before recorded history and may be traced through examples of clay reinforced with wood and other natural fibers, the papier mache of the ancient Egyptians and numerous combinations of wood with leather or metal. The technology behind some of these materials and their applications was no less ingenious than that for today's high performance structural composites, the origins of which can be pin-pointed with accuracy to the concepts and work of de Bruyne and Gordon in the late 1930s. In this article, a broad-brush outline is given of the history of the development of composites for use in aircraft primary structures, beginning with gelatin and starch reinforced with cellulose fibers and ending with the invention of carbon fibers and their use as a reinforcement for epoxy resins. Author

A84-42210

ELASTIC BEHAVIOUR OF COMPOSITE STRUCTURES UNDER LOW VELOCITY IMPACT

G. CAPRINO, I. CRIVELLI VISCONTI, and A. DI ILIO (Napoli, Università, Naples, Italy) Composites (ISSN 0010-4361), vol. 15, July 1984, p. 231-234. refs

The results of a study on the behavior of glass cloth/polyester panels under low velocity impact are reported. The experimental load/time curve in the elastic region showed good agreement with that predicted by a simple analytical model, based on energy considerations, using elastic properties obtained by static tests. The structural rigidity of the panels was not significantly affected by premature local shear damage, due to the concentration of load, even after first fiber failure. The strength of the material was found to be strongly rate-dependent; as a consequence the response of the structure in the post-elastic region cannot be predicted from the results of static tests. Author

A84-42651

HIGH-TEMPERATURE PROTECTIVE COATINGS; PROCEEDINGS OF THE SYMPOSIUM, ATLANTA, GA, MARCH 7, 8, 1983

S. C. SINGHAL, ED. (Westinghouse Research and Development Center, Pittsburgh, PA) Symposium sponsored by the Metallurgical Society of AIME and American Society for Metals. Warrendale, PA, Metallurgical Society of AIME, 1984, 371 p. For individual items see A84-42652 to A84-42668.

The present conference considers gas turbine airfoil protective coatings deposited by electron beam physical vapor deposition, vapor phase aluminization, and laser-treated plasma spraying, as well as interdiffusion effects on oxidation/resistant coatings for advanced single crystal superalloys, acoustic emissions from oxide cracking during alloy oxidation, and the optimization of MCr alloy coating compositions for marine gas turbines. Also discussed are the microstructural characterization of a service-exposed, CoCrAlY overlay coating, the corrosion failure of a gas turbine aluminide coating, steels with aluminized coatings, CVD-SiC coatings for ceramic heat exchanger tubes, the degradation of ceramic thermal barrier coatings, and the erosion of hard metal coatings. O.C.

A84-42652

ELECTRON BEAM PHYSICAL VAPOR DEPOSITION PROCESS FOR COATING GAS TURBINE AIRFOILS

W. K. HALNAN and D. LEE (Aircor Temescal, Berkeley, CA) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 3-12. refs

Electron Beam Physical Vapor Deposition (EB PVD) is a proven coating method for providing high temperature oxidation and corrosion protection to gas turbine airfoils. EB PVD coatings are well suited for airfoils ranging in size from small turbine blades weighing under 30 grams to large industrial vane segments weighing over 20 kilograms. The EB PVD coating process efficiencies have been improved by the use of multiple part holders and by tailoring the coating thickness. The EB PVD coating process results in a surface finish that is essentially the same as the substrate surface finish. These coatings can be applied to substrates with cooling holes with a minimum effect on hole closure. Author

A84-42653

VAPOR PHASE ALUMINIZING TO PROTECT TURBINE AIRFOILS

G. GAUJE and R. MORBIOLI (SNECMA, Direction Technique, Evry, Essonne, France) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 13-26. refs

The present vapor phase aluminizing superficial aluminum enrichment treatment for turbine airfoils requires no contact between the parts to be coated and the aluminum source. An aluminum-rich compound and a halide which effects the transfer of aluminum to the surface that is to be coated are employed.

Aluminum deposit rates depend on temperature, process duration and sealed muffle furnace internal environment. In addition to energy savings the low thermal inertia of the system allows a specific cooling cycle which ensures appropriate creep properties. O.C.

A84-42659

OXIDATION OF COCRALY AND Y-IMPLANTED COCRAL ALLOYS

J. A. SPRAGUE, F. A. SMIDT, JR. (U.S. Navy, Naval Research Laboratory, Washington, DC), S. Y. HWANG, G. H. MEIER, F. S. PETTIT (Pittsburgh, University, Pittsburgh, PA), and G. R. JOHNSTON IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 93-103. refs

(Contract N00014-81-K-0355)

The microstructural and morphological features of CoCrAlY overlay coatings' oxide scales, which form during either the fabrication of the coating or a coated engine component's initial operation, are not available at temperatures where low temperature hot corrosion is an important degradational factor (at around 700 C). Oxidation studies have been conducted in air at 700-1000 C for the cases of cast Co-22Cr-11Al-0.5Y and yttrium-implanted Co-22Cr-11Al. Various analytical techniques were used to characterize the oxide films and the near-surface alloy compositions. Voids are noted to have formed in the metal, at the metal/oxide interface, during the oxidation process, with size and density being dependent on the initial yttrium distribution in the surface of the alloy. O.C.

A84-42662

EVALUATION OF THE HIGH TEMPERATURE CORROSION RESISTANCE OF SOME COMMERCIAL COATINGS AND NEW DUPLEX COATINGS FOR GAS TURBINES

M. NAKAMORI, Y. HARADA, and I. HUKUE (Mitsubishi Heavy Industries, Ltd., Takasago, Hyogo, Japan) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 175-187. refs

The structure, adhesion and corrosion resistance of several protective coatings for use in gas turbines have been investigated. The coatings were Sermaloy J, Chromizing, Chromalloy RT-22, CoCrAlY coatings (electron beam-physical vapor deposition, low pressure plasma spray, ion plating) and duplex coatings of plasma-sprayed Ni-Cr alloy combined with either Cr or Al pack-cementation or with Al-Si slurry coating. CoCrAlY coatings produced by electron beam-physical vapor deposition and ion plating, and the duplex coatings, showed excellent corrosion resistance against V2O5-Na2SO4 and NaCl-Na2SO4 synthetic corrosion ash and excellent adhesion under cyclic thermal shock condition. The duplex coatings showed excellent properties, presumably due to diffusion layers formed between the spray layers and the base alloys after filling of the pores by pack-cementation or slurry coating. Author

A84-42663

MICROSTRUCTURAL CHARACTERIZATION OF SERVICE EXPOSED COCRALY OVERLAY COATING

C. J. SPENGLER (Westinghouse Research and Development Center, Pittsburgh, PA), S. T. SCHEIRER, and D. C. BARKSDALE (Westinghouse Electric Corp., Combustion Turbine Systems Div., Concordville, PA) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 189-200. refs

An electron beam-physical vapor deposition (EB-PVD) CoCrAlY coating was applied to vane segments of utility combustion turbines operated in regions where severe hot corrosion had historically been experienced. This corrosion/oxidation resistant coating was employed with high efficiency inlet air filters to reduce the likelihood of corrosion. Representative vanes were removed from turbines after up to 20,000 h of service for analysis; the deposits on the

vane surfaces contained CaSO_4 with less than 1 wt pct Na. Macroscopic and microstructural examination of the airfoil surfaces indicated no significant corrosion or pitting of the coating; where degradation did occur, it was related to microstructural and compositional variations in the as-applied coating and proceeded mostly by an oxidation mechanism. Chromium carbides and possible aluminum nitrides, as well as alumina particles, had formed in the coating. Possible coating corrosion mechanisms operative during service are compared with those simulated in the laboratory rig and those reported in the literature, where CaSO_4 was found to produce accelerated attack of cobalt-based alloys. Author

A84-42664

CASE STUDY OF CORROSION FAILURE OF AN ALUMINIDE COATING IN A GAS TURBINE

M. E. EL-DAHSHAN (King Saud University, Riyadh, Saudi Arabia) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 201-213. refs

The continual increases in the operating temperature of gas turbines, in addition to the necessity of using low grade fuels with higher contents of impurities, have stressed the need for the use of more stable superalloys. As most of the superalloys have been fully developed, the only way to achieve longer life, and high corrosion resistance, is through the surface coatings. This paper presents the case study of a coated turbine blade corroded in a turbine atmosphere. The failure of the coating could be attributed to one or more of: oxidation, thermal cycling, hot corrosion caused by impurities, erosion by unburned carbon from fuel and sand from the intake air, and finally, the interdiffusion of the coating with the base alloy. The course of attack seemed to follow the conventional route: the breakdown of the protective oxide layer, followed by corrosion propagated through the alloy, leading to the final morphology of attack. Author

A84-42666

GAS TURBINE ENGINE PERFORMANCE IMPROVEMENT USING CORROSION PREVENTIVE COATINGS

R. A. LANGLEY (Oklahoma City Air Logistics Center, Tinker AFB, OK) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 271-277.

The present investigation is concerned with a program designed to increase the fuel efficiency of the TF33 gas turbine aircraft engine. It was basically attempted to increase the compressor efficiency of the engine by smoothing out the surface of most of the airfoils in the engine. Two techniques were employed to achieve the desired smoothing of the airfoil surface. These techniques include the vibratory burnishing of the titanium airfoils and the smooth coating of the steel airfoils. Vibratory burnishing operations were conducted by utilizing vibratory abrasive cleaning equipment already available. The basic principle of operation is related to the removal of contaminants by the abrasive action of the vibrating mass of parts and cleaning media. Two different types of protective coatings were used on compressor vanes. G.R.

A84-42668* Westinghouse Research and Development Center, Pittsburgh, Pa.

DEGRADATION MECHANISMS OF CERAMIC THERMAL BARRIER COATINGS IN CORROSIVE ENVIRONMENTS

S. K. LAU and R. J. BRATTON (Westinghouse Research and Development Center, Pittsburgh, PA) IN: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983. Warrendale, PA, Metallurgical Society of AIME, 1984, p. 305-317. Research sponsored by the Electric Power Research Institute. refs
(Contract NAS3-21377)

Chemical as well as thermal-mechanical interactions between the ceramics and gas turbine combustion gases/condensates are found to play critical roles in the degradation of porous plasma-sprayed ceramic thermal barrier coatings. The detailed degradation mechanisms of several state-of-the-art ceramic thermal barrier coatings, including several zirconia compositions and a

calcium silicate, in corrosive environments are examined in this paper. Approaches to extend coating lifetime are also described.

Author

N84-28915*# Boeing Commercial Airplane Co., Seattle, Wash. ADVANCED COMPOSITE STABILIZER FOR BOEING 737 AIRCRAFT Quarterly Technical Progress Report, 19 Apr. - 18 Jul. 1978

18 Jul. 1978 150 p

(Contract NAS1-15025)

(NASA-CR-157639; NAS 1.26:157639; QTPR-4; DRL-018) Avail: NTIS HC A07/MF A01 CSCL 11D

Activities related to development of an advanced composites stabilizer for the Boeing 737 commercial transport are reported. Activities include discussion of criteria and objectives, design loads, the fatigue spectrum definition to be used for all spectrum fatigue testing, fatigue analysis, manufacturing producibility studies, the ancillary test program, quality assurance, and manufacturing development. M.A.C.

N84-28917*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECTS OF LONG-TIME ELEVATED TEMPERATURE EXPOSURES ON HOT-ISOSTATICALLY-PRESSED POWER-METALLURGY UDIMET 700 ALLOYS WITH REDUCED COBALT CONTENTS

F. H. HART 1984 18 p refs Presented at 113th Ann. Meeting of the Am. Inst. of Mining and Metallurgical and Petroleum Engr., Los Angeles, 26 Feb. - 2 Mar. 1984

(NASA-TM-83632; E-2071; NAS 1.15:83632) Avail: NTIS HC A02/MF A01 CSCL 11D

Because almost the entire U.S. consumption of cobalt depends on imports, this metal has been designated 'strategic'. The role and effectiveness of cobalt is being evaluated in commercial nickel-base superalloys. Udimet 700 type alloys in which the cobalt content was reduced from the normal 17% down to 12.7%, 8.5%, 4.3%, and 0% were prepared by standard powder metallurgy techniques and hot isostatically pressed into billets. Mechanical testing and microstructural investigations were performed. The mechanical properties of alloys with reduced cobalt contents which were heat-treated identically were equal or better than those of the standard alloy, except that creep rates tended to increase as cobalt was reduced. The effects of long time exposures at 760 C on mechanical properties and at 760 C and 845 C on microstructures were determined. Decreased tensile properties and shorter rupture lives with increased creep rates were observed in alloy modifications. The exposures caused gamma prime particle coarsening and formation of sigma phase in the alloys with higher cobalt contents. Exposure at 845 C also reduced the amount of MC carbides. Author

N84-28958*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CHEMICAL MECHANISMS AND REACTION RATES FOR THE INITIATION OF HOT CORROSION OF IN-738

G. C. FRYBURG, F. J. KOHL, and C. A. STEARNS Jul. 1984 34 p Submitted for publication

(NASA-TP-2319; E-1847; NAS 1.60:2319) Avail: NTIS HC A03/MF A01 CSCL 11F

Sodium-sulfate-induced hot corrosion of preoxidized IN-738 was studied at 975 C with special emphasis placed on the processes occurring during the long induction period. Thermogravimetric tests were run for predetermined periods of time, and then one set of specimens was washed with water. Chemical analysis of the wash solutions yielded information about water soluble metal salts and residual sulfate. A second set of samples was cross sectioned dry and polished in a nonaqueous medium. Element distributions within the oxide scale were obtained from electron microprobe X-ray micrographs. Evolution of SO was monitored throughout the thermogravimetric tests. Kinetic rate studies were performed for several pertinent processes; appropriate rate constants were obtained from the following chemical reactions: $\text{Cr}_2\text{O}_3 + 2 \text{Na}_2\text{SO}_4(1) + 3/2 \text{O}_2$ yields $2 \text{Na}_2\text{CrO}_4(1) + 2 \text{SO}_3(\text{g})$ $\text{TiO}_2 +$

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$\text{Na}_2\text{SO}_4(1)$ yields $\text{Na}_2\text{O}(\text{TiO}_2)_n + \text{SO}_3(\text{g})_n \text{TiO}_2 + \text{Na}_2\text{CrO}_4(1)$
yields $\text{Na}_2\text{O}(\text{TiO}_2)_n + \text{CrO}_3(\text{g})$. Author

N84-28966# Virginia Univ., Charlottesville.

THE USE OF NOVEL PROCESSING PROCEDURES FOR IMPROVING THE OVERALL FATIGUE RESISTANCE OF HIGH STRENGTH ALUMINUM ALLOYS Annual Scientific Report, 1 Jan. - 31 Dec. 1983

E. A. STARKE, JR. Feb. 1984 38 p

(Contract AF-AFOSR-0061-83; AF PROJ. 2306)

(AD-A141107; UVA/525638/MS84/101; AFOSR-84-0357TR)

Avail: NTIS HC A03/MF A01 CSCL 11F

Its objective is to develop an understanding of the mechanisms involved in the initiation and propagation of fatigue cracks in metals in order to optimize the microstructure of high strength aluminum alloys for overall fatigue resistance. The research conducted during this year was divided into three tasks. Task 1 was concerned with the effects of slip character and grain size on the intrinsic material and extrinsic closure contributions to fatigue crack growth resistance of 7475. Special thermal mechanical processing procedures were developed to control the microstructural features of interest. Task 2 was concerned with the use of the cyclic stress strain curve and a damage model for predicting fatigue crack growth thresholds. Fatigue crack initiation and fatigue crack propagation both involve the concept of cyclic accumulated damage. The details of the damage structure can be related to a material's cyclic stress strain response (CSSR). Task 3 is concerned with the effect of ion implantation on the low cycle fatigue response of 7475. Since fatigue crack initiation is a surface phenomenon and fatigue crack propagation is a bulk phenomenon, the fatigue properties may be optimized by production processes that develop microstructures resistant to FCI on the surface, and microstructures resistant to FCP throughout the bulk. GRA

N84-28972# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

CAUSES AND PREVENTION OF STRUCTURAL MATERIALS FAILURES IN NAVAL ENVIRONMENTS Progress Report

V. S. AGARWALA, D. A. BERMAN, and G. KOHLHAAS 1984 37 p

(AD-A141560; NADC-84039-60) Avail: NTIS HC A03/MF A01 CSCL 11F

An analysis is made of most corrosion related naval aircraft structural materials failure problems. The phenomena of stress corrosion cracking, hydrogen or environmental cracking, corrosion fatigue and exfoliation corrosion are discussed. Methods of determining hydrogen embrittling effects and hydrogen concentration are described and related to sustained load tolerances of cadmium plated high strength steels. An electro-mechanical test is described to illustrate the hydrogen-induced elastic deformation effect in steels. This test procedure has been also used to calculate the hydrogen diffusion coefficient as well as the hydrogen concentration. A technique which can monitor corrosivity of the naval environment aboard ship has been reported. Metallurgical methods of mitigating corrosion such as heat treatment and alloy development are described. Mechanistic aspects of corrosion-assisted mechanical failures (cracking) are analyzed and a multidisciplinary approach to solve the problem is described. It is demonstrated that modifications of the crack-tip chemistry can effectively lead to inhibition of corrosion fatigue and stress corrosion cracking in high strength alloys. Author (GRA)

N84-28995*# TRW, Inc., Redondo Beach, Calif. Energy Development Group.

IMPROVED HIGH TEMPERATURE RESISTANT MATRIX RESINS

G. E. CHANG, S. H. POWELL, and R. J. JONES Aug. 1983 71 p refs

(Contract NAS3-23274)

(NASA-CR-168210; NAS 1.26:168210; REPT-38945-6012-UT-00)

Avail: NTIS HC A04/MF A01 CSCL 11D

The objective was to develop organic matrix resins suitable for service at temperatures up to 644 K (700 F) and at air pressures up to 0.4 MPa (60 psia) for time durations of a minimum of 100 hours. Matrix resins capable of withstanding these extreme oxidative environmental conditions would lead to increased use of polymer matrix composites in aircraft engines and provide significant weight and cost savings. Six linear condensation, aromatic/heterocyclic polymers containing fluorinated and/or diphenyl linkages were synthesized. The thermo-oxidative stability of the resins was determined at 644 K and compressed air pressures up to 0.4 MPa. Two formulations, both containing perfluoroisopropylidene linkages in the polymer backbone structure, exhibited potential for 644 K service to meet the program objectives. Two other formulations could not be fabricated into compression molded zero defect specimens. Author

N84-28998# Dayton Univ., Ohio.

EFFECTS OF SURFACE FLAWS ON IMPACT RESISTANCE OF UNCOATED POLYCARBONATE Interim Technical Report, Jun. - Jul. 1981

M. P. BOUCHARD Wright-Patterson AFB, Ohio AFWAL Mar. 1984 23 p

(Contract F33615-80-C-3401; AF PROJ. 1926)

(AD-A141364; UDR-TR-82-74; AFWAL-TR-84-3016) Avail: NTIS HC A02/MF A01 CSCL 11I

Uncoated aircraft transparency polycarbonate is highly susceptible to surface abrasions. This report describes an experimental effort of limited scope to determine the effects of flaws on the resistance of polycarbonate to the impulsed, high energy loading conditions of bird impact. Test fixturing for flaw formation and high rate load application to polycarbonate beam specimens is described. It is demonstrated that polycarbonate is sensitive to changes in scratch profile and is less sensitive to changes in scratch depth. Net absorbed energy decreases with increasing scratch depth. However, scratches of any depth produce fracture if the scratch has a sharp, V-shaped profile. Author (GRA)

N84-29000# National Materials Advisory Board, Washington, D. C.

HIGH-PERFORMANCE, LOW-ENERGY-CURING RESINS Final Report

Mar. 1984 56 p

(Contract MDA903-82-C-0434)

(AD-A141524; NMAB-412) Avail: NTIS HC A04/MF A01 CSCL 11I

Resin systems that are curable at reasonable rates at ambient temperature, or at slightly elevated temperatures, are needed for temporary repair of composite structures on damaged airframes. However, efforts to date have not been successful in yielding properties useful at temperatures higher than the cure temperature. The committee reviewed the state of the art and recommended a number of approaches for supported research. These include preordered reactions, acrylate esters, reactive solvents, waveguide curing, epoxy resins, secondary ring closing reactions, donor-acceptor complexes, and the use of fillers, in conjunction with these approaches. Author (GRA)

N84-29008# Southwest Research Inst., San Antonio, Tex.
EFFECTS OF WEAR METAL ON LUBRICANT DEPOSITION Final Report, 1 Sep. 1981 - 1 Sep. 1983

J. C. TYLER, J. P. CUELLAR, JR., and R. L. MASON
 Wright-Patterson AFB, Ohio AFWAL Nov. 1983 99 p
 (Contract F33615-81-C-2021)
 (AD-A142027; SWRI-6721; AFWAL-TR-83-2078) Avail: NTIS
 HC A05/MF A01 CSCL 11H

The effects of wear metal on deposit forming characteristics of turbine engine lubricants were investigated, employing hot-wall deposition test rigs. The hot-wall section of the rigs was redesigned, fabricated and assembled for testing. A recently designed wear-metal generator was employed. Eight MIL-L-7808 or MIL-L-7808-type lubricants were evaluated under five different test conditions. Then a brief statistical analysis was performed to determine the micron filtration tests to be performed in a mitigation of wear-metal effects phase of the effort. Also, the effects on both kinematic viscosity and neutralization number of the test lubricants were determined. A direct calculation of wear-metal generation was provided by weight-loss measurements of the wear coupons mounted below the lubricant level in the sump. Also, the concentration of wear metals in samples of the test lubricants taken during testing was determined by atomic absorption spectrophotometer. The energy dispersive X-ray fluorescence technique was employed to determine trace elements in hot-wall deposit scrapings. The preliminary statistical analysis for all eight lubricants consisted of a one-way analysis of variance, then an analysis of covariance using an adjustment for wear, and finally an unadjusted analysis of variance. GRA

N84-29019# Monsanto Research Corp., Dayton, Ohio.
PROPERTIES OF AIRCRAFT FUELS AND RELATED MATERIALS Interim Report, 15 Feb. 1982 - 15 Jul. 1983

F. N. HODGSON, R. G. GABLE, and C. D. FRITSCH
 Wright-Patterson AFB, Ohio AFWAL Mar. 1984 215 p
 (Contract F33615-81-C-2035; AF PROJ. 3048)
 (AD-A141068; AFWAL-TR-84-2022) Avail: NTIS HC A10/MF
 A01 CSCL 21D

Fuel tests, analyses, and analytical method development were conducted on a number of fuels of an experimental nature in conjunction with ongoing Air Force programs for studying fuel combustion behavior, turbine engine design, and other fuel related technologies. Fuels from conventional and alternate sources were studied, as were fuels of the high density missile propellant type. A wide variety of both physical and chemical properties of the fuels were measured and are tabulated. Studies conducted to aid in the solution of operational problems are also reported.

Author (GRA)

N84-29923*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

STRESS-CORROSION CRACK-GROWTH STUDY OF TITANIUM ALLOY Ti-6Al-4V EXPOSED TO FREON PCA AND NITROGEN TETROXIDE MON-1

R. A. BJORKLUND *In APL The 1984 JANNAF Propulsion Meeting*, Vol. 1 p 221-232 Feb. 1984 refs Sponsored in part by AFSD

Avail: NTIS HC A17/MF A01 CSCL 11F

An experimental fracture-mechanics program was performed to determine the stress-corrosion crack-growth sensitivity of the propellant tank material, titanium alloy Ti-6Al-4V, for aerospace satellite applications involving long-term exposure to Freon PCA and nitrogen tetroxide MON-1. Sustained-load tests were made at a 49 C (120 F) constant temperature using thin-gauge tensile test specimens containing semielliptical surface flaws. Test specimen types included parent metal, center of weld, and weld-heat-affected zone. It was concluded that Ti-6Al-4V alloy is not adversely affected in a stress environment when exposed to Freon PCA for 1000 hours followed by exposure to nitrogen tetroxide MON-1 for 2000 hours at stress levels up to 80% of the experimental critical plane-strain stress-intensity factor. Author

N84-29963# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering.

ORGANIC AZIDES AS JET FUEL ADDITIVES: SYNTHESIS OF AZIDES AND MICRO-EXPLOSION CHARACTERISTICS OF DROPLETS

C. K. LAW, C. H. WANG, L. C. CLAUSEN, A. LEE, R. M. MORIARTY, B. R. BAILEY, S. C. ENGERER, and R. S. MILLER (ONR, Arlington, Va.) *In APL The 1984 JANNAF Propulsion Meeting*, Vol. 2 p 251-260 Feb. 1984 refs Prepared in cooperation with Illinois Univ., Chicago
 (Contract N00014-83-K-0207; N00014-83-K-0306)
 Avail: NTIS HC A15/MF A01 CSCL 21D

The chemical formulation and quantification of organic azides and the experimental investigation combustion and explosion characteristics of droplets of fuel/azide mixtures are discussed. Experimental results demonstrate that the presence of azido additives can cause the fuel droplet to catastrophically disintegrate. This micro-explosion event significantly enhances fine-scale mixing as a result of secondary droplet dispersion, and also slightly shortens the droplet lifetime and thereby increases the intensity of the heat release rate. The alkyl azides synthesized for these studies consist of low molecular weight compounds such as isopropyl and isobutyl azides, low molecular weight diazido alcohols such as 1,3-diazido 2-propanol and azido and diazido silyl ethers. Other systems which were synthesized are novel vinyl diazides and dimethylsilyldiazide. Higher molecular weight alkyl azides under investigation include norbornyl diazide and dimethyl diazidomalonate. M.G.

N84-29969*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ACEE COMPOSITE STRUCTURES TECHNOLOGY: REVIEW OF SELECTED NASA RESEARCH ON COMPOSITE MATERIALS AND STRUCTURES

Washington Aug. 1984 181 p refs Conf. held in Seattle, 13-16 Aug. 1984
 (NASA-CP-2321; L-15834; NAS 1.55:2321) Avail: NTIS HC
 A09/MF A01 CSCL 11D

The NASA Aircraft Energy Efficiency (ACEE) Composite Primary Aircraft Structures Program was designed to develop technology for advanced composites in commercial aircraft. Research on composite materials, aircraft structures, and aircraft design is presented herein. The following parameters of composite materials were addressed: residual strength, damage tolerance, toughness, tensile strength, impact resistance, buckling, and noise transmission within composite materials structures.

N84-29970*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RESIDUAL-STRENGTH TESTS OF L-1011 VERTICAL FIN COMPONENTS AFTER 10 AND 20 YEARS OF SIMULATED FLIGHT SERVICE

O. F. LOPEZ *In its ACEE Composite Struct. Technol.* p 1-16 Aug. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 11D

Part of the NASA/ACEE Program was to determine the effect of long-term durability testing on the residual strength of graphite-epoxy cover panel and spar components of the Lockheed L-1011 aircraft vertical stabilizer. The results of these residual strength tests are presented herein. The structural behavior and failure mode of both cover panel and spar components were addressed, and the test results obtained were compared with the static test results generated by Lockheed. The effect of damage on one of the spar specimens was described. R.S.F.

N84-29971*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WORLDWIDE FLIGHT AND GROUND-BASED EXPOSURE OF COMPOSITE MATERIALS

H. B. DEXTER and D. J. BAKER *In its* ACEE Composite Struct. Technol. p 17-50 Aug. 1984 refs
 Avail: NTIS HC A09/MF A01 CSCL 11D

The long-term durability of those advanced composite materials which are applicable to aircraft structures was discussed. The composite components of various military and commercial aircraft and helicopters were reviewed. Both ground exposure and flight service were assessed in terms of their impact upon composite structure durability. The ACEE Program is mentioned briefly.

R.S.F.

N84-29972*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF TOUGHENED COMPOSITE LAMINATES USING NASA STANDARD DAMAGE TOLERANCE TESTS

J. G. WILLIAMS, T. K. OBRIEN (Army Structures Lab.), and A. J. CHAPMAN, III *In its* ACEE Composite Struct. Technol. p 51-74 Aug. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 11D

The proposed application of composite materials to transport wing and fuselage structures prompted the search for tougher materials having improved resistance to impact damage and delamination. Several resin/graphite fiber composite materials were subjected to standard damage tolerance tests and the results were compared to ascertain which materials have superior toughness. In addition, test results from various company and NASA laboratories were compared for repeatability.

R.S.F.

N84-29973*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SYNTHESIS AND TOUGHNESS PROPERTIES OF RESINS AND COMPOSITES

N. J. JOHNSTON *In its* ACEE Composite Struct. Technol. p 75-96 Aug. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 11D

Tensile and shear moduli of four ACEE (Aircraft Energy Efficiency Program) resins are presented along with ACEE composite material modulus predictions based on micromechanics. Compressive strength and fracture toughness of the resins and composites were discussed. In addition, several resin synthesis techniques are reviewed.

R.S.F.

N84-29975*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IMPACT DYNAMICS RESEARCH ON COMPOSITE TRANSPORT STRUCTURES

H. D. CARDEN *In its* ACEE Composite Struct. Technol. p 113-136 Aug. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 11D

The experimental and analytical efforts being undertaken to investigate the response of composite and aluminum structures under crash loading conditions were reviewed. A Boeing 720 airplane was used in the controlled-impact demonstration test. Energy absorption of composite materials, the tearing of fuselage skin panels, the friction and abrasion behavior of composite skins, and the crushing behavior and dynamic response of composite beams were among the topics addressed.

R.S.F.

N84-29976*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
POSTBUCKLING BEHAVIOR OF GRAPHITE-EPOXY PANELS

J. H. STARNES, JR., J. N. DICKSON (Lockheed-Georgia Co.), and M. ROUSE *In its* ACEE Composite Struct. Technol. p 137-160 Aug. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 11D

Structurally efficient fuselage panels are often designed to allow buckling to occur at applied loads below ultimate. Interest in applying graphite-epoxy materials to fuselage primary structure led to several studies of the post-buckling behavior of graphite-epoxy

structural components. Studies of the postbuckling behavior of flat and curved, unstiffened and stiffened graphite-epoxy panels loaded in compression and shear were summarized. The response and failure characteristics of specimens studied experimentally were described, and analytical and experimental results were compared. The specimens tested in the studies described were fabricated from commercially available 0.005-inch-thick unidirectional graphite-fiber tapes preimpregnated with 350 F cure thermosetting epoxy resins.

R.S.F.

N84-29977*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STUDIES OF NOISE TRANSMISSION IN ADVANCED COMPOSITE MATERIAL STRUCTURES

L. A. ROUSSOS, M. C. MCGARY, and C. A. POWELL *In its* ACEE Composite Struct. Technol. p 161-178 Aug. 1983

Avail: NTIS HC A09/MF A01 CSCL 11D

Noise characteristics of advanced composite material fuselages were discussed from the standpoints of applicable research programs and noise transmission theory. Experimental verification of the theory was also included.

R.S.F.

N84-29979# Department of Energy, Washington, D. C.
ELECTROPOSITIVE BIVALENT METALLIC ION UNSATURATED POLYESTER COMPLEXED POLYMER CONCRETE Patent Application

T. SUGAMA, L. E. KUKACKA, and W. H. HORN, inventors (to DOE) 13 May 1983 23 p

(Contract DE-AC02-76CH-00016)

(DE84-011080; US-PATENT-APPL-SN-494484) Avail: NTIS HC A02/MF A01

Quick setting polymer concrete compositions are described which are mixtures of unsaturated polyesters and crosslinking monomers together with appropriate initiators and promoters in association with aggregate which may be wet and a source of bivalent metallic ions which will set to polymer concrete with excellent structural properties.

DOE

N84-30024# California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.

FATIGUE BEHAVIOR OF LONG AND SHORT CRACKS IN WROUGHT AND POWDER ALUMINUM ALLOYS Annual Report, 15 Apr. 1983 - 14 Apr. 1984

R. O. RITCHIE May 1984 205 p

(Contract AF-AFOSR-0181-82)

(AD-A142609; UCB/RP/84/A1021; AFOSR-84-0509TR) Avail:

NTIS HC A10/MF A01 CSCL 11F

The fatigue behavior of short cracks, which are small compared to the scale of the microstructure, small compared to the scale of local plasticity or simply physically small (i.e., approximately 1 mm), must be considered as one of the major factors limiting the application of defect-tolerant fatigue design for airframe and engine components. Accordingly, the current program is aimed at identifying factors which govern the growth of such short cracks (in contrast to long cracks) in a series of commercial aluminum alloys, with specific reference to behavior at near-threshold levels below (approximately 10 to the minus 6th power mm/cycle). In this second annual report, the status of the program is described in terms of: (1) an expanded review of the factors which lead to differences in long and short crack behavior, with particular regard to the role of crack closure mechanisms, (2) a description of experiments performed to characterize the role of microstructure in influencing the propagation of long cracks in 1/M 7150 aluminum alloys, and (3) a description of experiments carried out to isolate the effects of crack closure on the propagation of both long and short cracks, and specifically to investigate the location of the closure responsible for the development of a threshold.

GRA

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ENGINEERING

N84-30030# Pacific Northwest Lab., Richland, Wash.
SPUTTER-DEPOSITED METALLIC AND CERAMIC COATINGS FOR HEAT ENGINES Report, Oct. 1980 - Sep. 1983
 J. T. PRATER and R. W. MOSS Apr. 1984 71 p refs
 (Contract DE-AC06-76RL-01830)
 (DE84-011401; PNL-5013) Avail: NTIS HC A04/MF A01

Progress in the development of metallic and ceramic coatings with improved high-temperature corrosion and erosion/wear resistance is reported. The objective was to develop coatings that would insure that future heat engines, notably gas turbines and diesels, would be able to operate efficiently on degraded fuel supplies. The majority of coatings investigated were prepared by sputter deposition. Research on sputter-deposited CoCrAlY coatings was directed at improving their low-temperature, hot corrosion resistance by introducing composition gradients and adding platinum. Studies on sputter-deposited ZrO₂ and Al₂O₃ coatings were conducted to improve the thermal cycling resistance of ceramic deposits on metal substrates by using combinations of graded transition layers, columnar ceramic structures, and dense sealing layers. Preliminary results on plasma-sprayed Ni-SiC and quartz-SiC coatings that showed good wear and oxidation resistance are also reported. DOE

N84-30067# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF TEMPERATURE ON THE DELTA K SUB TH AND DA/DN OF LY-12CS ALUMINUM ALLOY

M. ZAIGIN, Y. HUAZI, and T. TIEZHONG *In its Aeron. Mater. (Selected Articles)* (FTD-ID(RS)-1868-83) p 63-79 13 Mar. 1984 refs Transl. into ENGLISH from Hangkong Cailiao (China), v. 2, no. 2, 1982

Avail: NTIS HC A09/MF A01 CSCL 11F

Central crack tension samples (CCT samples) in an air medium were used to test the fatigue threshold value Delta K (sub th) of LY-12CS aluminum alloy from room temperature to 250 C as well as the crack growth rate da/dN above the threshold value under 200 C three load ratio (R=0, 0.33, 0.67) conditions. Results showed that: (1) in the test temperature range, the threshold value Delta K (sub th) increased with the increases of the temperature; and (2) the rising temperature did not raise the crack growth rate da/dN below 250 C but lowered the da/dN. Under the conditions of three load ratios, Delta K ranged from 7 to 12 kg/mm(3/2) and the da/dN at room temperature was 1 to 3 times higher than that at 200 C. Author

N84-30106# Bureau of Mines, Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
AVIATION FUELS, 1983

E. M. SHELTON and C. L. DICKSON Apr. 1984 18 p refs
 (Contract DE-FC01-83FE-60149)
 (DE84-011823; NIPER-134-PPS-84/2) Avail: NTIS HC A02/MF A01

Properties of some aviation gasolines and aviation turbine fuels marketed in the United States during 1983 are presented. The samples represented are typical 1983 production and were analyzed in the laboratories of 12 manufacturers of aviation gasolines and 18 producers of aviation turbine (jet) fuels. The data were submitted for study, calculation, and compilation under a cooperative agreement between the National Institute for Petroleum and Energy Research (NIPER), Bartlesville, Oklahoma, and the American Petroleum Institute (API). Results for properties of 34 samples of grades 80/87, 100/130, and 100LL for aviation gasolines, and 104 samples of military grades JP-4 and JP-5, and commercial type Jet A for aviation turbine fuels are included. DOE

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A84-39874

A MARCHING METHOD FOR CALCULATING VISCOUS GAS FLOWS IN DUCTS [MARSHEVYI METOD RASCHETA TECHENII VIAZKOGO GAZA V KANALAKH]

P. A. VOINOVICH *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), vol. 24, June 1984, p. 944-947. In Russian. refs

A marching algorithm for calculating supersonic viscous gas flows in ducts is proposed which is characterized by high stability and accuracy. The results obtained using this method are compared with exact solutions and results obtained by an approximate method based on simplified Navier-Stokes equations. It is shown that the marching procedure proposed here can be successfully used for calculating flows in ducts of complex configurations. V.L.

A84-39973#

CALIBRATION AND USE OF AN ONERA MINIATURE FIVE HOLE PROBE

R. GAILLARD (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (Symposium on Measuring Techniques for Transonic and Supersonic Flow in Cascades and Turbomachines, 7th, Aachen, West Germany, Sept. 21-23, 1983) ONERA, TP, no. 1984-2, 1984, 18 p.

(ONERA, TP NO. 1984-2)

A five-hole conical probe for studying transonic and supersonic flows around small wind tunnel models is described. The probe, used in ONERA S5Ch wind tunnel trials, has been sized down to 1.5 mm and employed in flow speeds ranging from Mach 0.4-2.6 and at angles from 0-40 deg. The probe holes have been tapped normal to the probe axis. A 60 deg cone angle was selected after calibration trials. Accuracies of 2-5 percent have been obtained for the Mach number and 0.2-0.4 deg for the flow angle. Sample data are provided for flow upstream and downstream of a supersonic compressor cascade. M.S.K.

A84-39975#

FINITE ELEMENT MODEL ADJUSTMENT USING EXPERIMENTAL VIBRATION DATA

H. BERGER, J. P. CHAQUIN, and R. OHAYON (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) (International Model Analysis Conference, 2nd, Orlando, FL, Feb. 6-9, 1984) ONERA, TP, no. 1984-1, 1984, 6 p. refs
 (ONERA, TP NO. 1984-1)

Two finite element models are presented for analyzing the vibrational behavior of a structure. The structure is treated as a distribution of mass and known eigenmodes. The measured modes are inserted into the equilibrium equations as displacements at the boundary. Errors are localized by uniform measurements around the body in one method. A second correction method, defined because the presence of nonzero stress vectors makes the finite element operators erroneous, involves corrections by minimizing the Euclidean norm of the reaction forces, i.e., the error areas are linearly parameterized in the stiffness matrix. Sample calculations are provided for an axisymmetric composite structure and a beam model of an aircraft wing. M.S.K.

A84-40242* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A REVIEW OF INTERNAL COMBUSTION ENGINE COMBUSTION CHAMBER PROCESS STUDIES AT NASA LEWIS RESEARCH CENTER

H. J. SCHOCK (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 13 p. refs (AIAA PAPER 84-1316)

The performance of internal combustion stratified-charge engines is highly dependent on the in-cylinder fuel-air mixing processes occurring in these engines. Current research concerning the in-cylinder airflow characteristics of rotary and piston engines is presented. Results showing the output of multidimensional models, laser velocimetry measurements and the application of a holographic optical element are described. Models which simulate the four-stroke cycle and seal dynamics of rotary engines are also discussed. Previously announced in STAR as N84-24999

R.S.F.

A84-40248* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPTIMIZATION OF FRINGE-TYPE LASER ANEMOMETERS FOR TURBINE ENGINE COMPONENT TESTING

R. G. SEASHOLTZ, L. G. OBERLE, and D. H. WEIKLE (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 17 p. refs (AIAA PAPER 84-1459)

The fringe type laser anemometer is analyzed using the Cramer-Rao bound for the variance of the estimate of the Doppler frequency as a figure of merit. Mie scattering theory is used to calculate the Doppler signal wherein both the amplitude and phase of the scattered light are taken into account. The noise from wall scatter is calculated using the wall bidirectional reflectivity and the irradiance of the incident beams. A procedure is described to determine the optimum aperture mask for the probe volume located a given distance from a wall. The expected performance of counter type processors is also discussed in relation to the Cramer-Rao bound. Numerical examples are presented for a coaxial backscatter anemometer. Previously announced in STAR as N84-25019

Author

A84-40656* Northwestern Univ., Evanston, Ill.

MIXED TIME INTEGRATION SCHEMES FOR TRANSIENT CONDUCTION FORCED-CONVECTION ANALYSIS

W. K. LIU and J. I. LIN (Northwestern University, Evanston, IL) IN: Numerical properties and methodologies in heat transfer. Washington, DC, Hemisphere Publishing Corp., 1983, p. 83-95. refs

(Contract NAG1-210)

A partition procedure for forced-convection conduction transient problems is presented. Mixed time partitions are defined wherein coupled conduction force-matrix equations are discretized using an implicit integration method, followed by derivation of a mixed time integration technique. Explicit-implicit and explicit-explicit partitions are performed for a stability analysis for transient conditions, e.g., those found in an actively air-cooled engine and airframe structure.

M.S.K.

A84-40667

NUMERICAL SOLUTIONS FOR FLOW AND HEAT TRANSFER OF A PLANE TURBULENT OBLIQUE IMPINGING JET

J. C. HWANG and F. K. TSOU (Drexel University, Philadelphia, PA) IN: Numerical properties and methodologies in heat transfer. Washington, DC, Hemisphere Publishing Corp., 1983, p. 403-417. refs

(Contract N68335-79-C-2055)

A two-equation model of turbulence was applied to obtain the solution of elliptic equations that govern the flow and heat transfer of an incompressible, plane, turbulent jet impinging obliquely on a flat surface. The case of $H/D = 30$, $Re = 45000$, $\alpha = 70$ deg and constant wall temperature boundary condition was

considered. The results of computation, including velocity profiles, friction coefficients, and Nusselt numbers are in good agreement with available data.

Author

A84-40678

ACOUSTIC EMISSION DUE TO CRACK GROWTH, CRACK FACE RUBBING AND STRUCTURAL NOISE IN THE CC-130 HERCULES AIRCRAFT

S. L. MCBRIDE and J. W. MACLACHLAN (Royal Military College of Canada, Kingston, Ontario, Canada) Journal of Acoustic Emission (ISSN 0730-0050), vol. 3, Jan.-Mar. 1984, p. 1-9. Research supported by the Department of National Defense of Canada. refs

A structure containing a precracked, 7075-T6 aluminum specimen was attached directly to the inner-fuselage frame of a CC-130 aircraft. Specific inflight maneuvers were performed to cause the airframe to apply loads to the specimen which are conducive to crack advance and crack-face rubbing at identifiable and different times during the flight. Acoustic emission noise tests were also carried out with sensors attached directly to the airframe in three locations inside the fuselage of the aircraft. It is shown that crack advance, crack-face rubbing and airframe noises can be readily distinguished from one another by examination of the voltage-time behavior of the acoustic emission signal envelopes. It is further shown by correlation of the applied load with signal occurrence that a crack advance of 20 microns was detected by acoustic emission during flight. Crack presence was also detected by acoustic emission from crack-face rubbing noises detected at times of minimum load.

Author

A84-40682

PRECISION BUILDUP METHOD DRAWS A BEAD ON CONDEMNED JET ENGINE PARTS

M. TECKLENBURG (Hobart Brothers Co., Troy, OH) Welding Journal (ISSN 0043-2296), vol. 63, July 1984, p. 51, 52.

The present investigation is concerned with a welding method which has become a means of economically rebuilding jet engine knife edge seals and blades. For the maintenance of performance and fuel economy, a jet engine requires constant internal pressures, and knife edge rotary seals must be designed to discourage bypass routes. Wear on the knife edge seal makes it necessary to rebuild the knife edges by depositing weld metal on the seals. The considered method is specifically designed to rebuild thin edges by depositing thin weld beads one on top of the other. It uses the gas tungsten arc welding (GTAW) process and an oscillated motion of the cold wire feed. As the filler metal wire comes into the arc, it cools the weld pool, and when retracted, it, in turn, is cooled for the next cycle. The new method increases productivity, eliminates operator fatigue, minimizes rework, and reduces the cost of filler metal wire. The considered method can also be employed for other types of repair work.

G.R.

A84-40804

MANUFACTURING PROCEDURES AND THEIR RELATION TO FAILURES IN LANDING GEAR COMPONENTS

M. D. BROWN (Colt Industries, Montreal, Canada) and G. J. FOWLER (Failure Analysis Associates, Los Angeles, CA) IN: ISTFA 1982 - International Symposium for Testing and Failure Analysis; Proceedings of the Symposium, San Jose, CA, October 25-27, 1982. Torrance, CA, International Society for Testing and Failure Analysis, 1982, p. 242-253.

Conventional manufacturing procedures and quality control used in the production of aircraft landing gear are discussed in terms of their reliability. Photographic results of fractographic analysis are presented. The particular problems examined include: raw material defects, forging defects, and failure induced as a result of defects in manufacturing processing, finishing and assembly. The contributions toward the successful analytical resolution of service failures and the subsequent improvement in manufacturing and processing as a result of failure analysis is illustrated in a number of case histories.

I.H.

A84-40829#**TURBULENT BOUNDARY LAYER BEHIND CONSTANT VELOCITY SHOCK INCLUDING WALL BLOWING EFFECTS**

H. MIRELS (Aerospace Corp., Aerophysics Laboratory, El Segundo, CA) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1042-1047. refs

(Contract F04701-82-C-0083)

Previously cited in issue 5, p. 637, Accession no. A83-16794

A84-40843#**GENERAL EQUATIONS OF MOTION FOR AN ELASTIC WING AND METHOD OF SOLUTION**

V. J. E. STARK (Saab-Scania AB, Linköping, Sweden) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 380-388) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1146-1153. Research supported by the Forsvaret Materielverk. refs

Previously cited in issue 12, p. 1743, Accession no. A83-29847

A84-40922#**EXPERIMENTAL VERIFICATION OF THE LEONHARD'S CRITERIUM OF STABILITY IN ROTOR-DYNAMICS**

V. STEFFEN, JR. (Uberlandia, Universidade Federal, Uberlandia, Brazil) and H. LECOANET (Franché-Comte, Université, Besançon, France) IN: Joint Conference on Experimental Mechanics, Oahu and Maui, HI, May 23-28, 1982, Proceedings. Part 1. Brookfield Center, CT, Society for Experimental Stress Analysis, 1984, p. 192-195.

Stability is a very important design point in rotor-dynamics. This paper concerns the application of the Leonhard's Criterium of stability to a system composed of a flexible rotor supported by journals presenting nonsymmetrical stiffness matrix. The results are compared to the qualitative behavior of an experimental model represented by a flexible shaft supporting a disk in a certain position between the journals. Author

A84-40994**VIBRATION CONFERENCE 1982, NEU-ULM, WEST GERMANY, OCTOBER 7, 8, 1982, REPORTS [SCHWINGUNGSTAGUNG 1982, NEU-ULM, WEST GERMANY, OCTOBER 7, 8, 1982, VORTRAEGE]**

Conference sponsored by the Verein Deutscher Ingenieure. VDI-Berichte (ISSN 0083-5560), no. 456, 1982, 295 p. In German.

The measurement, analysis, and control of vibration (V) are discussed, with a focus on the design of industrial machines, tools, and vehicles. The main subject areas covered are V effects on man, experimental modal analysis, nonlinear V, and useful V. Among the topics examined are measurement instrumentation and techniques for determining the effects of V on man, whole-body V, V on ships, V effects in the hand-arm system, V control by optimization of the spring/shock-absorber/seat system, computation of nonlinear quasi-periodic V in machine components with slip joints, structure-oriented modeling and identification of multibody systems, V behavior of a rotor with a transverse crack, support and damping analysis of homogeneously distributed systems, comparison of experimental-modal and finite-element analyses of natural V in open thin-walled profiles, modal analysis in the construction of turbine groups, and holographic interferometry for V measurements on rapidly rotating components. No individual items are abstracted in this volume T.K.

A84-41129#**WAVE MODELS OF TURBULENT FLOW OVER COMPLIANT SURFACES**

J. E. FFOWCS-WILLIAMS (Cambridge University, Cambridge, England) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, July 1984, p. 364-368.

Some modelling techniques for studying how sound evolves from unsteady boundaries are discussed, and acoustic analogies for the evolution of flow are presented. The modelling techniques

are based on analogies presented by Lighthill (1952) and are thought to be useful in quantitative examination of the problem of jet noise. The influence of mean flow, the role of hydrodynamic instabilities, and the connection between noise and drag effects are illustrated both mathematically and schematically. It is found that acoustic power absorption at a moving surface is intimately connected with drag reduction potential, and that the degree to which power flows from the surface can determine the amount of inviscid drag. It is estimated that as much as 20 percent of inviscid drag is due to skin friction on a rigid surface. I.H.

A84-41646**MATHEMATICAL METHODS USED IN A MASTER-GEOMETRY SYSTEM [MATEMATICKE METODY POUZITE V SYSTEMU ETALONNI GEOMETRIE]**

P. FRANC Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 25-30. In Czech.

Geometrical objects used in a master-geometry system are enumerated. A description is given of mathematical and computational procedures employed in geometric operations with simple geometric objects and objects defined in terms of parts. Examples of operations with cubic curves and bicubic surfaces are considered, and attention is given to the transformation of curves by broken lines with the required accuracy. B.J.

A84-41647**THE USE OF A MASTER-GEOMETRY SYSTEM AND COMPUTER TECHNIQUES IN TECHNICAL PRODUCTION PREPARATION AND THE PRODUCTION OF AIRCRAFT PARTS [UPLATNENI SYSTEMU ETALONNI GEOMETRIE A VYPOCEJNI TECHNIKY V TECHNICKÉ PŘÍPRAVĚ VÝROBY A VÝROBE SOUČASTÍ]**

S. SICH Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 31-35. In Czech.

Consideration is given to the use of a master-geometry system for the preparation of machine numerical-control programs for the production of gauges, forming jigs, and shaped parts of assembly fixtures in aircraft production. The digital notation of shape and dimensional information on aircraft parts, influencing the overall geometry of the aircraft, assures the objective transmission of this information through the entire sequence of production preparation stages and makes possible the production of the aforementioned parts by means of numerically controlled machines. Detailed consideration is given to the development of control programs for the production of gauges and fixtures. B.J.

A84-41655**THE USE OF COMPUTER TECHNIQUES FOR AEROELASTIC CALCULATIONS AT NP LET [VYUZITI POCITACE PRO AEROELASTICKE VÝPOČTY V N.P. LET]**

J. RUZICKA Zpravodaj VZLU (ISSN 0044-5355), no. 2, 1984, p. 107-114. In Czech. refs

Computer-aided aeroelastic calculations are examined with respect to the state-of-the-art, methods used, and other possibilities. Attention is given to analyses of mass distribution in the aircraft, the natural frequencies of structural members, flutter, the reversal of control surfaces, the divergence of lifting surfaces, and lift redistribution on elastic surfaces. Finally, possible ways to improve present aeroelastic calculations are considered, and examples of graphic outputs are presented. B.J.

A84-41656**CALCULATION OF THE OPTIMAL DESIGN PARAMETERS OF A STIFFENED PANEL BY MEANS OF MATHEMATICAL PROGRAMMING [VYPOCET OPTIMALNÍHO NAVRHU VÝZTUŽENÉHO PANELU METODOU MATEMATICKEHO PROGRAMOVÁNÍ]**

A. PISTEK Zpravodaj VZLU (ISSN 0044-5355), no. 2, 1984, p. 115-121. In Czech. refs

In an application of mathematical programming to calculate the optimal structural design of a stiffened panel, the objective function, the weight of the panel, and the constraints are analyzed for all forms of stability failure including the static-strength requirement. Constraints of structural-engineering type are also

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considered, and the design approach is illustrated by the case of a stiffened wing panel of a light transport aircraft. B.J.

A84-41659

ANALYSIS OF THE CRITICAL STRESS FOR LOCAL INSTABILITY BY THE METHOD OF FINITE STRIPS [VYPOCET KRITICKEHO NAPETI LOKALNI ZTRATY STABILITY METODOU KONECNYCH PASU]

A. PISTEK Zpravodaj VZLU (ISSN 0044-5355), no. 3, 1984, p. 159-164. In Czech. refs

Stiffness matrices and geometrical stiffness matrices depending on buckling half-wavelength are derived for a particular form of the displacement function suitable for stiffened panels and thin-walled stringers. Examples which illustrate the application on the finite strip method are presented, including results on the postbuckling behavior of the structure. B.J.

A84-41780#

APPLICATION OF FRACTURE MECHANICS TO HUB-ARMS OF HELICOPTER

T. ZHAO, Y. WANG (Huazhong Institute of Technology, People's Republic of China), and R. YU (Jiangxi Aeronautical Society, Jiangxi, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, March 1984, p. 30-36. In Chinese, with abstract in English.

Journal fracture in helicopter hub-arms has been analyzed using fracture mechanics. For simplicity, the journal is regarded as a cylinder with a transverse surface crack under bending load. Taking the crack area as the main parameter, the compliance of the cylinder is obtained along with the energy release rate and the stress intensity factor. The area rate of fatigue crack propagation is used to express the features of fatigue crack propagation in the cylinder. Experimental studies confirmed the validity of this approach. The critical crack propagation area and the residual life expectancy of the journal are discussed, based on the theoretical and experimental results. C.D.

A84-41785#

DYNAMICAL ANALYSIS OF A TWO-GIMBAL MASS-UNBALANCED DYNAMICALLY TUNED GYROSCOPE

H. WANG (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 5, March 1984, p. 67-74. In Chinese, with abstract in English. refs

The dynamical equations for a two-gimbal, dynamically tuned gyroscope with mass imbalance in both the rotors and the gimbals are developed based on ideal suspension. The effects of linear acceleration on the gyro's drift are analyzed, and it is found that, although the mass center of the rotor and the gimbals does not coincide with the suspension center, the drift effect due to the twice spin frequency angular vibration may be eliminated by proper selection and adjustment of the principal moments of inertia of the gimbals. If the vehicle experiences constant linear acceleration or acceleration of twice the spin frequency about the axes normal to the drive shaft, erratic disturbing torques acting on the rotor will emerge. These torques will also emerge if the vehicle experiences linear acceleration of identical spin frequency in the direction of the drive shaft. Formulas for the gyro drift for all types of spin frequency linear vibration inputs are given. C.D.

A84-41938

ULTRASONICS ASSISTS TOUGH MATERIAL MACHINING

B. S. PARK (U.S. Army, Washington, DC) ManTech Journal, vol. 9, no. 1, 1984, p. 33-42. Army-supported research.

The results of an evaluation of a tool post for ultrasonic activation of cutting tools are reported. The system was tested on a turret lathe turning, difficult-to-machine wrought metal alloys including ESR 4340 steel, 4340 steel, 9310 steel, 17-4 PH steel, several titanium alloys, and Refractaloy. With the ultrasonic assist, metal removal was found to increase by factors up to 730 percent, tool wear and tool breakage were reduced and tool chatter was eliminated. Ultrasonically cut chips had a larger curl radius indicating lessened strain, lower hardness, and less heat discoloration than

chips cut by conventional means. It is recommended that the ultrasonic tool post be installed on a turret lathe and tested in a production environment. I.H.

A84-42206

ON THE OPTICAL ASSESSMENT OF THE VOID CONTENT IN COMPOSITE MATERIALS

D. PURSLOW (Royal Aircraft Establishment, Materials and Structures Dept., Farnborough, Hants., England) Composites (ISSN 0010-4361), vol. 15, July 1984, p. 207-210.

The nature and practical classification of voids detected in composite materials by means of two simple optical techniques are discussed. The 'optical comparison' technique involves an optical microscope of X 240 magnification in order to arrive at a void content estimate, using a 10 x 10 square graticule in the eyepiece. The 'optical counting' technique samples the area in a regular pattern (such as a square) to note the presence or absence of a void; by counting the number of times that the exact center of any small square lies over some part of a void, a statistical assessment of the void content can be made. This technique is also applicable to the determination of fiber content. O.C.

A84-42338*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MODELING CLEAR-AIR TURBULENCE WITH VORTICES USING PARAMETER-IDENTIFICATION TECHNIQUES

R. S. MEHTA (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 123-130. refs (AIAA PAPER 84-2083)

A vortex model of winds associated with clear-air turbulence (CAT) is shown to be useful for characterizing actual airline CAT encounters. The model consists of an array of vortices with solid-body cores embedded in a potential flow field. Parameters such as the size and strength of the vortices and their locations are identified using a modified Newton-Raphson algorithm. A manual identification start-up scheme is used to minimize errors in the initial parameter estimates, and the identification algorithm is found to be robust in regard to the remaining errors. The analysis of a CAT encounter involving a commercial airliner demonstrates the success of the model and estimation procedure. The analysis finds vortices with core diameters of 1000 ft and tangential velocities of 87 ft/sec in this encounter. Author

A84-42406

THE USE OF IMAGE DEROTATED HOLOGRAPHIC INTERFEROMETRY IN STUDYING THE RESONANT RESPONSE OF GAS TURBINE ENGINE BLADED-DISK

J. F. CLARADY and J. L. BEARDEN (United Technologies Corp., Government Products Div., West Palm Beach, FL) IN: Engineering applications of optical measurements; Proceedings of the Fall Meeting, Hartford, CT, November 7-10, 1982. Brookfield Center, CT, Society for Experimental Stress Analysis, 1982, p. 29-33. refs

A84-42415

VIBRATIONS OF BLADED DISK ASSEMBLIES; PROCEEDINGS OF THE NINTH BIENNIAL CONFERENCE ON MECHANICAL VIBRATION AND NOISE, DEARBORN, MI, SEPTEMBER 11-14, 1983

D. J. EWINS, ED. (Imperial College of Science and Technology, London, England) and A. V. SRINIVASAN, ED. (United Technologies Research Center, East Hartford, CT) Conference sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers, 1983, 165 p. For individual items see A84-42416 to A84-42424.

Consideration is given to several experimental and theoretical investigations of the vibration of bladed disks in fan and turbine engine applications, including studies of frequency and mode shape of axisymmetric bladed structures in jet engines, free and forced vibration in turbine blades, friction-damped resonant stress in turbine blades, modal analysis and parameters for twisted

compressor blades, the effect of variable root flexibility on the vibration response of shrouded blades, and the resonant response of mistuned bladed disks. Attention is also given to several methods for measuring vibration-related stress in turbine blades. I.H.

A84-42419#

MODAL ANALYSIS AND PARAMETER IDENTIFICATION FOR TWISTED COMPRESSOR BLADES BY MEANS OF IMPULSE EXCITATION

Z. F. FU (Jiaotong University, Shanghai, People's Republic of China) and H. T. ZHOU IN: Vibrations of bladed disk assemblies; Proceedings of the Ninth Biennial Conference on Mechanical Vibration and Noise, Dearborn, MI, September 11-14, 1983. New York, American Society of Mechanical Engineers, 1983, p. 73-81. refs

A method of experimental modal analysis for twisted compressor blade is described in this paper. As the compressor blade is a light structure with complex surface figure and low damping, there are some special problems in analysis and measurement that must be overcome. These problems such as the measurement and analysis of multi-directional transfer function, the frequency zoom transform, anti-aliasing, the checks of non-linearity and reciprocity are also described in this paper. In addition, the results of test and analysis for a twisted compressor blade are given. Author

A84-42617*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PROGRESS IN NATURAL LAMINAR FLOW RESEARCH

B. J. HOLMES (NASA, Langley Research Center, Subsonic Aerodynamics Branch, Hampton, VA) American Institute of Aeronautics and Astronautics and NASA, General Aviation Technology Conference, Hampton, VA, July 10-12, 1984. 10 p. refs

(AIAA PAPER 84-2222)

For decades, since the earliest attempts to obtain natural laminar flow (NLF) on airplanes, three classical objections to its practicality have been held in the aeronautical community. These objectives concerned first, the capability to manufacture practical airframe surfaces smooth enough for NLF; second, the apparent inherent instability and sensitivity of NLF; and third, the accumulation of contamination such as insect debris in flight. This paper explains recent progress in our understanding of the achievability and maintainability of NLF on modern airframe surfaces. This discussion explains why previous attempts to use NLF failed and what has changed regarding the three classical objections to NLF practicality. Future NASA research plans are described concerning exploring the limits of NLF usefulness, production tolerances, operational considerations, transition behavior and measurement methods, and NLF design applications. Author

N84-29043# National Oceanic and Atmospheric Administration, Boulder, Colo.

COMPARISON OF AIRBORNE TURBULENCE-INDICATING DOPPLER RADAR SYSTEMS WITH GROUND-BASED DOPPLER RADAR SYSTEMS Final Report, 15 May 1981 - 15 Mar. 1982

B. L. TROTTER 13 Jan. 1983 54 p

(Contract DTFA01-81-Y-10557)

(AD-A141474; DOT/FAA/PM-84/3) Avail: NTIS HC A04/MF A01 CSCL 17I

To promote air safety, FAA has undertaken the task of maintaining current knowledge of the state of the design of turbulence-indicating weather radars. The airborne turbulence-indicating radar is a translation of ground-based radar technology to the airborne environment. Comparisons are made between data sets of the airborne turbulence-indicating radars and a ground-based Doppler radar with turbulence (second moment) capabilities. No comparison is intended between the airborne systems. Author (GRA)

N84-29057# Institute for Defense Analyses, Alexandria, Va.

F/A-18 AN/APG-65 RADAR CASE STUDY REPORT (IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY) STUDY Final Report, Jul. 1982 - Aug. 1983

P. F. GOREE Aug. 1983 287 p

(Contract MDA903-79-C-0018)

(AD-A142103; AD-E500658; IDA-D-20; IDA/HQ-83-25930) Avail: NTIS HC A13/MF A01 CSCL 17I

This document records the activities and presents the findings of the F/A-18 AN/APG-65 Radar Case Study Working Group part of the IDA/OSD Reliability and Maintainability Study, conducted during the period from July 1982 through August 1983. GRA

N84-29077# AEG-Telefunken, Ulm (West Germany). Geschaeftsbereich Hochfrequenztechnik.

A 60 GHZ PULSE RADAR FOR DETECTION OF HIGH VOLTAGE POWER LINES Final Report, Dec. 1982

H. G. WIPPICH, B. REMBOLD, H. CALLSEN, and A. PLATTNER Bonn Bundesministerium fuer Forschung und Technologie Apr. 1984 69 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-W-84-013; ISSN-0170-1339) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 14,50

A helicopter borne radar able to detect high power transmission lines 20 mm diameter at a distance 500 m is described. Radar power at 60 GHz constituted the critical point, but by using avalanche diodes, sufficient power for a radius of 600 m is possible. The following components were developed: mm-wave radar, scanner and mount, data processing and power supply, and laboratory display of data (C-Scope). Author (ESA)

N84-29080# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Trans-Ueberschall-Entwurfsverfahren.

WAVE PROPAGATION FROM MOVING SINGULARITIES AND A UNIFIED EXPOSITION OF THE LINEARIZED THEORY FOR AERODYNAMICS AND ACOUSTICS

A. DAS Mar. 1984 70 p refs

(DFVLR-FB-84-17) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 22

The physical nature of spatial and temporal stretching effects arising from the motion of the singularities which influence wave propagation from moving disturbance sources, as occurring in electromagnetic, acoustic, and aerodynamic fields is analyzed. The singularities consisting of volume elements and surface elements possess arbitrary orientation in space and to the trajectory. Hence generally valid formulas for the stretching functions, which reveal universal relations and characteristic properties in the radiation field are obtained. A unified method for the solution of the linearized theory which is universally applicable for aerodynamics and acoustics is outlined. Author (ESA)

N84-29118# McGraw-Edison Co., St. Louis, Mo.

SOLID STATE POWER CONTROLLER FUSE DEVELOPMENT PROGRAM Final Report, Aug. 1981 - Jul. 1983

V. R. SPAUHORST, W. H. CURTIS, and V. KALRA Wright-Patterson AFB, Ohio AFWAL 1 Oct. 1983 294 p

(Contract F33615-81-C-2052)

(AD-A142118; AFWAL-TR-83-2070) Avail: NTIS HC A13/MF A01 CSCL 10B

The purpose of this development program is to design a family of fail-safe fuses (2-30A, 28VDC, 115/230V-400 Hz) for applications in aircraft electrical systems solid state power controllers (SSPCs). The SSPC functions as a circuit interrupter and a load controller, and when operating properly should protect the aircraft wiring between itself and the load. However, if the SSPC fails to open during a short or overload condition, excessive current can flow, resulting in serious damage to aircraft wiring. The purpose of the SSPC fuse is to prevent wire damage in this double fault condition. Author (GRA)

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N84-29151*# Ohio State Univ., Columbus.

A NUMERICAL SIMULATION OF THE DISPERSAL OF AERIAL SPRAYS

M. B. BRAGG Hampton, Va. NASA. Langley Research Center
Nov. 1981 110 p refs
(Contract NASA ORDER L-7965-B)
(NASA-CR-165816; NAS 1.26:165816; AARL-TR-81-0) Avail:
NTIS HC A06/MF A01 CSCL 20D

A computer program was developed to predict the trajectory, ground deposition, and drift of liquid sprays injected into the wake of an agricultural aircraft in ground effect. The program uses a horseshoe vortex wake model and includes the effects of liquid droplet evaporation, crosswind, the propeller slipstream, ground effect, and tunnel walls on small scale models. This user's guide includes several case examples demonstrating user options. A complete listing of the FORTRAN program is provided. Author

N84-29152*# Scientific Research Associates, Inc., Glastonbury, Conn.

THREE-DIMENSIONAL UNSTEADY VISCOUS FLOW ANALYSIS OVER AIRFOIL SECTIONS Final Report

B. C. WEINBERG and S. J. SHAMROTH Jun. 1984 68 p refs
(Contract NAS1-17573)
(NASA-CR-172368; NAS 1.26:172368; R84-900027F) Avail:
NTIS HC A04/MF A01 CSCL 20D

A three-dimensional solution procedure for the approximate form of the Navier-Stokes equation was exercised in the two- and three-dimensional modes to compute the unsteady turbulent boundary layer on a flat plate corresponding to the data of Karlsson. The procedure is based on the use of a consistently split Linearized Block Implicit technique in conjunction with a QR operator scheme. New time-dependent upstream boundary conditions were developed that yielded realistic solutions for the interior in the vicinity of the upstream boundary. Comparisons of the computation employing these boundary conditions with the data indicate that both qualitative and quantitative agreement was obtained for the mean velocity and the in phase and out of phase components of the first harmonic of the velocity. In addition, the calculation gave results for the skin friction phase angle that had expected physical behavior for large distances downstream of the inflow boundary. For the three-dimensional case, the two-dimensional data of Karlsson was considered, but in a coordinate system skewed at 45 deg to the free stream direction. The results of the calculations were in excellent agreement with the data and the two-dimensional computations. Author

N84-29161*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Aerospace and Ocean Engineering Dept.

REAL JET EFFECTS ON DUAL JETS IN A CROSSFLOW Semiannual Report

J. A. SCHETZ Aug. 1984 18 p refs
(Contract NAG2-256)
(NASA-CR-173817; NAS 1.26:173817) Avail: NTIS HC A02/MF A01 CSCL 20D

A 6-ft by 6-ft wind tunnel section was modified to accommodate the 7-ft wide NASA dual-jet flate model in an effort to determine the effects of nonuniform and/or noncircular jet exhaust profiles on the pressure field induced on a nearby surface. Tests completed yield surface pressure measurements for a 90 deg circular injector producing exit profiles representative of turbofan nozzles (such as the TF-34 nozzle). The measurements were obtained for both tandem and side-by-side jet configurations, jet spacing of $S/D = 2$, and velocity ratios of $R = 2.2$ and 4.0. Control tests at the same mass flow rate but with uniform exit velocity profiles were also conducted, for comparison purposes. Plots for 90 deg injection and $R = 2.2$ show that the effects of exit velocity profile nonuniformity are quite significant. A.R.H.

N84-29162# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

SECONDARY FLOWS AND ENDWALL BOUNDARY LAYERS IN AXIAL TURBOMACHINES

1984 484 p refs Lecture Series held at Rhode Saint Genese, Belgium, 7-11 May 1984
(VKI-LS-1984-05) Avail: NTIS HC A21/MF A01

Secondary flow theory in straight and annular cascades; secondary loss prediction methods; experimental research on secondary flows in annular turbine cascades; three dimensional rotational inviscid flow calculation; annulus endwall boundary layer theory; calculation of three dimensional viscous flows in annular cascades using parabolized Navier-Stokes equations; and low aspect ratio turbine design are covered.

N84-29169# Rolls-Royce Ltd., Derby (England).

LOW ASPECT RATIO TURBINE DESIGN AT ROLLS-ROYCE

S. MORGAN In Von Karman Inst. for Fluid Dyn. Secondary Flows and Endwall Boundary Layers in Axial Turbomachines 89 p 1984 refs
Avail: NTIS HC A21/MF A01

Low aspect ratio turbine flowpath, vortex philosophy, surface velocity distributions, stacking, and manufacturing and cooling considerations are discussed. The Turbine Aerodynamic Cooling Interactive User Suite computer code for turbine design is described. Three dimensional analysis in a low aspect ratio high pressure stator design is outlined. Author (ESA)

N84-29173# Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Ballistic Research Lab.

AN EXPLANATION OF SPIN-UP INSTABILITIES FOR A 155MM BINARY PROJECTILE Final Report

W. P. DAMICO, JR. Apr. 1984 30 p
(Contract DA PROJ. 1L1-62618-AH-80)
(AD-A141534; AD-F300426; ARBRL-MR-03355) Avail: NTIS HC A03/MF A01 CSCL 19A

In 1971 during the development testing of the 155mm XM687 binary projectile, liquid-induced flight instabilities were observed. Tests were conducted that indicated unstable behavior for fill ratios of 80 to 100%. However, stable flights occurred for a fill ratio of 65%. A solid, cylindrical spacer was fitted to the interior of the aft end of the rear payload canister, thus shortening the overall interior length of the payload compartment. This simple modification yielded stable flights and was incorporated into the standard projectile. This report presents yawsonde data and analytical models that explain the stabilizing effect of the spacer which was eventually employed in the M687 projectile. GRA

N84-29234# Rolls-Royce Ltd., Derby (England). Design Dept.

THE INITIAL MECHANICAL DESIGN OF HOT GAS TURBINE BLADING USING LIMITED INFORMATION

A. G. DODD 29 Aug. 1983 27 p refs Presented at Metals Soc. Conf. on Designing with High Temp. Mater., Sheffield, Engl., 20-22 Sep. 1983
(PNR-90183; REPRINT-896; DDR-1099) Avail: NTIS HC A03/MF A01

A method to outline rotor blade mechanical design of each gas turbine stage, specifying material choice, cross sectional areas, rim loads on disks and level of cooling technology required for commercially satisfactory life was devised. The method uses only the data available at the early stages of project design, simplifies constraints to allow rapid iteration, and is confined to defining an outline for further detailed design and analysis. Failure mechanisms are handled by choosing a temperature or stress for each radial position on a blade within creep and temperature criteria lines plotted on a stress against mean metal temperature field. Blades are optimized within this field by varying either cooling technology level or by changing cross sectional area to vary stress.

Author (ESA)

N84-29245*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

STRUCTURES AND DYNAMICS DIVISION RESEARCH AND TECHNOLOGY PLANS FOR FY 1984 AND ACCOMPLISHMENTS FOR FY 1982

K. S. BALES Jun. 1984 130 p
(NASA-TM-85828; NAS 1.15:85828) Avail: NTIS HC A07/MF A01 CSCL 20K

The Objectives, Expected Results, Approach, and Fiscal Year FY 1984 Milestones for the Structures and Dynamics Division's research programs are examined. The FY 1983 Accomplishments are presented where applicable. M.A.C.

N84-29248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MODE 2 FATIGUE CRACK GROWTH SPECIMEN DEVELOPMENT

R. J. BUZZARD, B. GROSS, and J. E. SRAWLEY 1983 18 p refs Presented at the 17th Natl. Symp. on Fracture Mech., Albany, N.Y., 7-9 Aug. 1984; sponsored by Am. Soc. for Testing and Mater.

(NASA-TM-83722; E-2108; NAS 1.15:83722) Avail: NTIS HC A02/MF A01 CSCL 20K

A Mode II test specimen was developed which has potential application in understanding phenomena associated with mixed mode fatigue failures in high performance aircraft engine bearing races. The attributes of the specimen are: it contains one single ended notch, which simplifies data gathering and reduction; the fatigue crack grows in-line with the direction of load application; a single axis test machine is sufficient to perform testing; and the Mode I component is vanishingly small. Author

N84-29253# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.

AEROELASTIC PROBLEMS CAUSED BY TORNADOS AND THEIR SUCCESSFUL TREATMENT WITH TECHNOLOGIES THAT RESULT FROM EXPERIENCES OF PRECEDENT INTENSIVE TECHNOLOGIC MODERNIZING [BEI DER ENTWICKLUNG DES TORNADOS AUFGETRETENE AEROELASTISCHE PROBLEME UND IHRE ERFOLGREICHE BEHANDLUNG DURCH TECHNOLOGIEN, DIE AUS DEN ERFAHRUNGEN VORANGEGANGENER TECHNOLOGIE-INTENSIVER RUESTUNGSPROGRAMME HERVORGINGEN]

J. SCHOEN 12 Apr. 1983 38 p refs In GERMAN (MBB-FE294/S/PUB/110) Avail: NTIS HC A03/MF A01

The airframe structure of the Tornado aircraft is examined. The development of the airplane is described. The aeroelastic properties and the dynamic loads were observed during construction of the various swinging parts. Aeroelastic problems noted during the development of the aircraft are outlined.

Transl. by E.A.K.

N84-30139# National Bureau of Standards, Washington, D.C. Center for Building Technology.

DIRECTIONAL EXTREME WIND SPEED DATA FOR THE DESIGN OF BUILDINGS AND OTHER STRUCTURES Final Report

M. J. CHANGERY (National Climatic Center), E. J. DMITRIU-VALCEA, and E. SIMIU Mar. 1984 127 p refs (PB84-178847; NBS-BSS-160; LC-84-601008) Avail: NTIS HC A07/MF A01 CSCL 13M

The purpose is to provide largest yearly fastest-mile wind speed data corresponding to winds blowing from each octant at 37 airport stations in the United States. Four sets of data are presented. The first set consists of largest yearly fastest-mile wind speeds at 24 stations as extracted from original records. The second set consists of largest yearly fastest-mile wind speeds at 13 stations as extracted from Local Climatological Data (LCD) summaries. The third and fourth sets consist of the data from the first and second sets reduced to a height of 10 m above ground. Information on possible differences between extreme data extracted from original records on the one hand and from LCD summaries on

the other hand is given. Procedures for estimating extreme wind effects that take into account the directional characteristics of the extreme wind climate and of the aerodynamic behavior of the structure are briefly reviewed, and it is noted that additional research on sampling errors in the estimation of extreme wind effects appears to be warranted. Author (GRA)

N84-30156# Coast Guard Research and Development Center, Groton, Conn.

EVALUATION OF U.S. COAST GUARD FORWARD-LOOKING AIRBORNE RADARS Final Report, Feb. 1983 - Feb. 1984

H. G. KETCHEN, J. ST. MARTIN, G. L. HOVER, and T. J. MAZOUR Mar. 1984 86 p
(AD-A142417; USCG-D-17-84) Avail: NTIS HC A05/MF A01 CSCL 171

During CY 1983, the U.S. Coast Guard R&D Center conducted field experiments off Fort Pierce, FL and Oregon Inlet, NC to evaluate the small-target detection capabilities of three forward-looking airborne radars (FLARs): the AN/APS-127, the AN/APS-133, and the AN/APN-215. Field data from these experiments and from a West German field test of the AN/APN-134 FLAR were compared to each other and to theoretical detection range predictions promulgated by NADC. These data were used to analyze the potential of each system to fulfill the Coast Guard Search and Rescue (SAR) and Enforcement of Laws and Treaties (ELT) missions. Targets of 1-square meter and 100-square meter radar cross sections were considered in the analysis. The AN/APS-134 was found to be clearly superior to the other three candidate FLAR systems in its capability to fulfill SAR and ELT mission requirements. In sea states 3 and above, the AN/APS-134 is the only FLAR among those evaluated with any significant ability to detect 1-square meter targets. Recommendations are made for conducting FLAR search operations and for future research and development efforts. Author (GRA)

N84-30159# Megapulse, Inc., Bedford, Mass.

AN EXPERIMENTAL INVESTIGATION OF THE IMPROVEMENT IN THE RECEPTION OF TM (TRANSVERSE MAGNETIC)-POLARIZED LF (LOW-FREQUENCY) WAVES WITH A TWO-ELEMENT SPACED ARRAY Interim Report

F. M. TINGLEY and R. C. KAHLER Griffiss AFB, N.Y. RADC May 1984 52 p
(Contract F19628-80-C-0146)
(AD-A142478; RADC-TR-84-91) Avail: NTIS HC A04/MF A01 CSCL 17B

For this study, a 2-element spaced array antenna system was developed and tested. This array consisted of two well-spaced vertical loops combined with a microwave link. The array was tested to show improvements in signal-to-noise ratio over omnidirectional antennas, using received transmissions from an aircraft towing a long wire antenna. Gains in signal-to-noise ratio of up to 12.8 dB were demonstrated. Author (GRA)

N84-30178# Defence Research Establishment, Ottawa. (Ontario).

RAPID ELECTROLYTE EXCHANGE PROCEDURES FOR 22 AH NICKEL-CADMIUM CELGARD CELLS

G. VERVILLE and P. POWELL Apr. 1984 17 p
(AD-A142004; DREO-TN-83-25) Avail: NTIS HC A02/MF A01 CSCL 10C

State-of-the-health analysis of Nickel-Cadmium aircraft batteries rejected as being unsatisfactory by CF bases has shown that most of the problems encountered can be related to the fact that the KOH concentration in the cells is too low and/or the carbonate concentration is too high. Exchange of electrolyte restored the performances of the cells but is time consuming, one to two weeks for a battery using the charge-KOH exchange-discharge procedure. The present technical note describes some of the tests performed and a procedure for rapidly exchanging the electrolyte in 22 AH Nickel-Cadmium Aircraft Celgard cells. Author (GRA)

12 ENGINEERING

N84-30211# Sandia Labs., Albuquerque, N. Mex.
LIGHTNING SIMULATOR CIRCUIT PARAMETERS AND PERFORMANCE FOR SEVERE-THREAT, HIGH-ACTION-INTEGRAL TESTING

R. A. WHITE 1984 14 p refs Presented at the Intern. Conf. on Lightning and Static Elec., Orlando, Fla., 22 Jun. 1984 (Contract DE-AC04-76DP-00789) (DE84-009065; SAND-83-2254C; CONF-8406100-2) Avail: NTIS HC A02/MF A01

The lightning simulator at Sandia National Laboratories was used to subject a number of DOE and military test items to severe levels of simulated lightning. Some example circuits and circuit parameters are discussed in relation to tests made with this crowbarred Marx-generator type simulator. Examples of fast rising, high peak, long duration simulated lightning currents that were produced into full size test items are presented. Peak currents up to 250 kA with 1-(μ s) rise times and action values up to greater than 6 million A(2)s was injected into various test systems. DOE

N84-30223*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ATOMIZATION OF LIQUID SHEETS IN HIGH PRESSURE AIRFLOW

R. D. INGEBO 1984 18 p refs Proposed for presentation at the Winter Ann. Meeting of the American Society of Mechanical Engineers, New Orleans, 9-14 Dec. 1984 (NASA-TM-83731; E-2207; NAS 1.15:83731) Avail: NTIS HC A02/MF A01 CSCL 20D

An investigation of liquid sheet atomization is made with combustor simulated inlet air pressures varied from 0.10 to 2.1 MPa. Mean drop diameters are measured with an improved scanning radiometer and correlated with the liquid and air stream Reynolds numbers, RE(1) and RE(A) and the airstream pressure sensitive group GC(2). These data are used in the modeling of the combustion process. M.A.C.

N84-30233# Naval Postgraduate School, Monterey, Calif.
SURFACE DISTURBANCES DUE TO TRAILING VORTICES Progress Report, 30 Dec. 1983 - 30 Mar. 1984

T. SARPKAYA and D. O. HENDERSON, JR. Mar. 1984 159 p (Contract ARPA ORDER 3925) (AD-A142693; NPS69-84-004) Avail: NTIS HC A08/MF A01 CSCL 20D

The characteristics of the surface signatures resulting from the interaction of the trailing vortices with the free surface have been investigated both theoretically and experimentally. The vortices were created through the use of three lifting surfaces of different shape and aspect ratio (two Delta wings and a rectangular foil). The surface disturbances have been classified into two groups (striations and scars) and the evolution of each type has been expressed in terms of the governing parameters such as the depth of generation of vortices, mutual induction velocity, and the initial vortex spacing. It has been shown that the surface signatures are a consequence of the strain field resulting from the nonuniform surface-velocity distribution and that they are not simple capillary-gravity waves. A turbulence model has been used to establish reasonable correlation between the theoretical and experimental results. Author (GRA)

N84-30293*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TRANSMISSION EFFICIENCY MEASUREMENTS AND CORRELATIONS WITH PHYSICAL CHARACTERISTICS OF THE LUBRICANT

J. J. COY, A. M. MITCHELL, and B. J. HAMROCK 1984 20 p refs Proposed for presentation at the 64th Symp. of the Propulsion and Energetics Panel on Gears and Transmission Systems for Helicopters and Turboprops, Lisbon, 8-12 Oct. 1984; sponsored by AGARD Prepared in cooperation with Army Research and Technology Labs.

(NASA-TM-83740; E-2167; NAS 1.15:83740; USAAVSCOM-TR-84-C-11) Avail: NTIS HC A02/MF A01 CSCL 11H

Data from helicopter transmission efficiency tests were compared to physical properties of the eleven lubricants used in those tests. The tests were conducted with the OH-58 helicopter main rotor transmission. Efficiencies ranged from 98.3 to 98.8 percent. The data was examined for correlation of physical properties with efficiency. There was a reasonable correlation of efficiency with absolute viscosity if the viscosity was first corrected for temperature and pressure in the lubricated contact. Between lubricants, efficiency did not correlate well with viscosity at atmospheric pressure. Between lubricants, efficiency did not correlate well with calculated lubricant film forming capacity. Bench type sliding friction and wear measurements could not be correlated to transmission efficiency and component wear. Author

N84-30294*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUMMARY OF DRIVE-TRAIN COMPONENT TECHNOLOGY IN HELICOPTERS

G. J. WEDEN and J. J. COY 1984 24 p refs Proposed for presentation at the NATO-AGARD PEP 64th Symp. on Gears and Power Transmissions for Helicopters and Turboprops, Lisbon, 8-12 Oct. 1984 Prepared in cooperation with Army Research and Technology Labs.

(Contract DA PROJ. 1L1-61101-AH-45) (NASA-TM-83726; E-1296; NAS 1.15:83726; USAAVSCOM-TR-84-C-10) Avail: NTIS HC A02/MF A01 CSCL 13I

A review of current helicopters was conducted to determine the technology in the drive-train systems. The design features are highlighted including reliability characteristics in transmission systems for the OH-58, UH-1, CH-47, and UH-60 helicopters. In addition, trade-offs involving cost, reliability and life are discussed. Author

N84-30297# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Thermique Appliquee.

TWO-DIMENSIONAL AND QUASI THREE-DIMENSIONAL EXPERIMENTAL STANDARD CONFIGURATIONS FOR AEROELASTIC INVESTIGATIONS IN TURBOMACHINE-CASCADES

T. FRANSSON and P. SUTER 30 Sep. 1983 199 p (Contract AF-AFOSR-0251-81; AF-AFOSR-0063-83) (AD-A141904; EPFL/LTA-TM-83-2) Avail: NTIS HC A09/MF A01 CSCL 20D

The aeroelastician needs reliable, efficient methods for the calculation of unsteady blade forces in turbomachines. The validity of such theoretical or empirical prediction models can only be established if researchers apply their flutter and forced vibration predictions to a number of well documented experimental test cases. In the present report, the geometrical and time-averaged flow conditions of nine two-dimensional or quasi three-dimensional experimental standard configurations for aeroelasticity in turbomachine cascades are given. For each configuration some aeroelastic test cases are defined, comprising different incidence angles, Mach numbers, interblade phase angle, reduced frequencies, etc. Furthermore a proposal for unified nomenclature and reporting formats is included, in order to facilitate the comparison between the different experimental data and the theoretical results. Author (GRA)

N84-30301# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

A DATA ACQUISITION AND REAL-TIME DISPLAY SYSTEM FOR TESTING A JET ENGINE COMPRESSOR Interim Report, Jan. 1980 - Jan. 1982

D. S. LEONARD Wright-Patterson AFB, Ohio AFWAL Mar. 1984 54 p

(Contract AF PROJ. 3066)

(AD-A142696; AFWAL-TR-83-2091) Avail: NTIS HC A04/MF

A01 CSCL 13G

A test was conducted by the Air Force Aero Propulsion Laboratory to study the performance of jet engine compressors during engine speed transients. Effective analysis of the test results required accurate, high speed data acquisition during the transients. On-line reduction and display of the performance data was desirable to improve the efficiency of the test operations. This paper describes the software that was designed and implemented to acquire and display the performance data. The software controls data acquisition and calibration equipment, provides on-line calibration of transducers, records the data, reduces and displays performance data (including graphics), and allows the test operator to control these functions.

Author (GRA)

N84-30310# Northern Research and Engineering Corp., Woburn, Mass.

ENGINEERING RESEARCH ON POSITIVE DISPLACEMENT GAS EXPANDERS, PHASE 1

R. E. LORD Feb. 1984 54 p refs

(Contract DE-AC02-83CE-40652)

(DE84-008977; DOE/CE-40652/1; REPT-1514-2) Avail: NTIS

HC A04/MF A01

A research, design, and development program related to positive displacement gas expanders is reported. The objective of this program is to develop and demonstrate a more cost effective gas expander for use in those waste heat recovery systems which utilize an Organic Rankine Cycle. To provide a lower cost machine, the gas expander uses a positive displacement concept, rather than a turbine as used currently. Several positive displacement machine concepts were examined, and various performance measures were developed for each of the concepts. The machine concepts were: single and multiple cylinder reciprocators, radial piston, roller piston, sliding vane, trochoidal, helical screw, and lobed rotor. For each of the concepts, designs were generated for machines operating with three different sets of operating conditions. These designs were then used to develop measures of efficiency and cost, and to examine other characteristics of the machines, such as development risk and ability to operate with different flow, pressure, and temperature levels. Based upon an evaluation of these characteristics, a specific concept was selected for further development. This concept is a double acting, single cylinder reciprocating machine with crossheads and ceramic liners.

DOE

N84-30320# Dayton Univ., Ohio.

FLAW DETECTION RELIABILITY CRITERIA. VOLUME 1: METHODS AND RESULTS Final Technical Report, May 1982 - Sep. 1983

A. P. BERENS and P. W. HOVEY Apr. 1984 170 p

(Contract F33615-82-C-5030)

(AD-A142001; UDR-TR-83-137-VOL-1;

AFWAL-TR-84-4022-VOL-1) Avail: NTIS HC A08/MF A01

CSCL 14B

Air Force inspection limits for damage tolerance analyses have been defined as those crack lengths for which there is 95 percent confidence that at least 90 percent of all cracks will be detected. This definition of inspection limit cannot be used in structural risk assessments as it is not linked to the probability of missing the flaws that may be present in a structure. This program investigated alternate methods of defining flaw detection reliability criteria and, in particular, focuses on a characterization based on a fixed probability of having cracks greater than the inspection limit after the inspection. A major part of the program was devoted to methods of estimating the POD (Probability of Crack Detection) function

from inspection reliability demonstration experiments. These methods are extensively discussed.

Author (GRA)

N84-30329*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IMPROVED METHODS OF VIBRATION ANALYSIS OF PRETWISTED, AIRFOIL BLADES

K. B. SUBRAHMANYAM and K. R. V. KAZA 1984 37 p refs

Presented at the 16th Intern. Congr. of Theoretical and Appl. Mech., Lyngby, Denmark, 19-25 Aug. 1984; sponsored by the International Union of Theoretical and Applied Mechanics and the Technical Univ. of Denmark

(NASA-TM-83735; E-2175; NAS 1.15:83735) Avail: NTIS HC

A03/MF A01 CSCL 20K

Vibration analysis of pretwisted blades of asymmetric airfoil cross section is performed by using two mixed variational approaches. Numerical results obtained from these two methods are compared to those obtained from an improved finite difference method and also to those given by the ordinary finite difference method. The relative merits, convergence properties and accuracies of all four methods are studied and discussed. The effects of asymmetry and pretwist on natural frequencies and mode shapes are investigated. The improved finite difference method is shown to be far superior to the conventional finite difference method in several respects. Close lower bound solutions are provided by the improved finite difference method for untwisted blades with a relatively coarse mesh while the mixed methods have not indicated any specific bound.

Author

N84-30331*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FATIGUE AND FRACTURE BRANCH: A COMPENDIUM OF RECENTLY COMPLETED AND ON-GOING RESEARCH PROJECTS

W. ELBER Jun. 1984 76 p

(NASA-TM-85825; NAS 1.15:85825) Avail: NTIS HC A05/MF

A01 CSCL 20K

This compendium of recently completed and ongoing research projects from the Fatigue and Fracture Branch at NASA Langley Research Center provides technical descriptions and key results of all such projects expected to lead to publication of significant findings. The common thread to all these studies is the application of fracture mechanics analyses to engineering problems in metals and composites, with particular emphasis on airframe structural materials. References to recent publications are included where appropriate.

Author

N84-30333# Aeronautical Research Labs., Melbourne (Australia).

STRAINS IN AN ELASTIC PLATE CONTAINING AN INTERFERENCE-FIT BOLT NEAR A FREE EDGE

G. S. JOST and R. P. CAREY 1984 30 p

(AR-003-012; ARL-STRUC-REPT-400) Avail: NTIS HC A03/MF

A01

The elastic stresses in a semi-infinite plate with a pressurized hole are derived, along with the relationship between the interface pressure and interference. Approximate average radial expansion of the hole with radial bolt contraction is calculated. The location of the onset of yielding is ascertained. Strain level is used to determine yield incipience. Agreement between predicted and measured strains is good. The approximation to relate average bolt/hole interface pressure to interference for the present non-axisymmetric case is very successful.

S.B.

12 ENGINEERING

N84-30336# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

EFFECTS OF VARIATIONS IN COLDWORKING REPAIR PROCEDURES ON FLAW GROWTH AND STRUCTURAL LIFE Final Report, Nov. 1979 - Dec. 1980

J. M. PEARSON-SMITH and J. M. POTTER Apr. 1984 29 p (AD-A141966; AFWAL-TR-82-3030) Avail: NTIS HC A03/MF A01 CSCL 01C

Out-of-tolerance cold hole expansion can occur during scheduled maintenance of aircraft structures. Personnel responsible for the maintenance of aircraft structures must make decisions as to the acceptability of any deviation from repair specifications. The decision to accept or reject an out-of-tolerance repair can be significant in a scheduled maintenance situation since a rejection will normally involve a major integral component of structure. A rejection of a discrepant hole at the repair stage can mean scrapping of the component with the potential of thousands of person-hours for replacement and refurbishment. The purpose of this research effort was to investigate the effect of out-of-tolerance cold hole expansion on flaw growth and structural life. To accomplish this goal, specimens were prepared and fatigue tested under spectrum loading conditions to failure. Typical discrepancies found in structures undergoing repair were simulated for this effort. Crack length measurements were periodically obtained during the spectrum test and the resultant fatigue lives were noted. Crack growth behavior and fatigue lives for the holes with discrepant preparation were compared to those of properly prepared specimens. GRA

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

N84-29296# Environmental Research Inst. of Michigan, Ann Arbor. Radar Div.

THE USE OF SATELLITE AND AIRCRAFT SAR TO DETECT AND CHART HAZARDS TO NAVIGATION Final Report, Aug. 1982 - Aug. 1983

E. S. KASISCHKE, R. A. SHUCHMAN, J. D. LYDEN, G. A. MEADOWS, and D. R. LYZENG Aug. 1983 331 p (Contract N00014-82-C-2308; N00014-76-C-1048) (AD-A141658; ERIM-163000-2-F) Avail: NTIS HC A15/MF A01 CSCL 08C

A total survey of SEASAT and SIR-A L-band Synthetic Aperture Radar (SAR) imagery for the presence of bottom-related surface patterns was completed. Aircraft X-band SAR data collected by an APD-10 system was also reviewed. Examples from these three SAR systems are presented which further illustrate the types of bottom-related surface patterns which appear on SAR imagery. A comparison of digital SAR image intensities versus depth data demonstrates the correlation of the SAR surface patterns to bottom features, and when combined with ancillary environmental data, demonstrates the dependence of SAR surface patterns on the ambient environmental conditions. First order hydrodynamic/electromagnetic models are presented which demonstrate how bottom-related surface patterns appear on SAR images. GRA

N84-29369# Army Construction Engineering Research Lab., Champaign, Ill.

COMMUNITY REACTION TO IMPULSIVE NOISE: A 10-YEAR RESEARCH SUMMARY Final Technical Report

P. D. SCHOMER and R. D. NEATHAMMER Feb. 1984 209 p (Contract DA PROJ. 4A1-62720-A-896) (AD-A141762; CERL-TR-N-167) Avail: NTIS HC A10/MF A01 CSCL 01C

A major concern of Army planners is the trend toward siting off-installation housing and other noise-sensitive land uses in areas exposed to high noise levels produced by Army training or operational activities. To do effective noise-related assessments and planning the Army must be able to assess the community reaction to impulse noise. Impulsive noise is produced by Army noise sources like armor, artillery, and demolition. This collection of papers summarizes 10 years of work by the U.S. Army Construction Engineering Research Laboratory (CERL) in the area of community response to impulsive noise. It is based on laboratory tests using a blast noise simulator, a study of Army-wide noise complaints, and attitudinal surveys conducted at Fort Bragg, NC, and Fort Lewis, WA. The attitudinal surveys provide most of the data. GRA

N84-29404# National Severe Storms Lab., Norman, Okla.

INVESTIGATION OF THE DETECTABILITY AND LIFETIME OF GUST FRONTS AND OTHER WEATHER HAZARDS TO AIRCRAFT Final Report, Feb. 1982 - Oct. 1983

D. S. ZRNIC and J. T. LEE Washington FAA Oct. 1983 60 p (Contract DTFA01-81-Y-10521; FAA PROJ. 156-410-01W) (AD-A141552; FAA-PM-83-33) Avail: NTIS HC A04/MF A01 CSCL 04B

Low-altitude wind shear associated with diverging outflows has been related to several aircraft accidents. We examine several gust fronts using Doppler radar data and measurements from surface stations and tall tower. We present radar-derived parameters such as reflectivity, height, maximum shear, peak velocity, distance of the front from the producing storm and the nearest 30 dBZ contour for several gust fronts within 60 km of the radar during 1980 to 1982. For all orientations of the front, even along the radial direction, the frontal discontinuity was evident in both mean velocity and spectrum width fields. Thus, while detection is practical with a single Doppler radar, accurate estimation of shear magnitudes is more difficult when the frontal discontinuity is aligned along the radial. Several downdrafts of different sizes are present simultaneously behind some of the fronts and the maximum measured shear of radial velocities produced by one downdraft was .02/s. A more typical value of 100/s was observed at several locations. Maximum azimuthal shear of 470/s occurred at the wave crest. GRA

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MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A84-40143

AIRCRAFT AND SPACECRAFT CONTROL [UPRAVLENIE AVIATSIONNYMI I KOSMICHESKIMI APPARATAMI]

B. N. PETROV Moscow, Izdatel'stvo Nauka (B. N. Petrov Izbrannye Trudy, Volume 2), 1983, 328 p. In Russian. refs

The second edition of a collection of essays and articles on aircraft and spacecraft control by one of the founders of the Soviet space program is presented. Attention is given to general technical problems of aircraft control systems, including attitude control, control of spacecraft during reentry, and control of aircraft and

spacecraft propulsion systems. Some technical issues in the design of automatic flight control systems, flight data management systems on board aircraft and spacecraft, and the application of data processing technology to radiosounding experiments in space are also briefly discussed. I.H.

A84-40607**THE APPLICATION OF MICROPROCESSOR TECHNOLOGY IN FLIGHT SIMULATION**

R. L. SCHWING (Singer Co., Link Flight Simulation Div., Binghamton, NY) IN: Space - The next twenty years; Proceedings of the Twentieth Space Congress, Cocoa Beach, FL, April 26-28, 1983. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1984, p. IB-57 to IB-60.

In the manufacture of flight simulators, it becomes from time to time necessary to make basic changes regarding the simulator architecture in response to new requirements with respect to simulator performance. At present, the industry is probably only at the beginning of a cycle in which more and more training capabilities will be provided as part of the simulator package. The approaches available for satisfying the new requirements are considered. The title 'MicroSimulation Technology' (MST) was coined to describe the next-generation simulator architecture because of strong expectations as to the role which modern MSI, LSI, and VLSI products would play. A Light Jet Trainer, introduced in early 1982, dispenses with minicomputers entirely and uses for computing purposes an interconnected network of six microprocessors. Major improvement in computation speed must come from the utilization of concurrent processing. For software, an environment is sought which is hardware independent. G.R.

A84-40766**FORECASTING MAXIMUM SPEED OF AEROPLANES - A CASE STUDY IN TECHNOLOGY FORECASTING**

D. N. P. MURTHY and K. C. STAIB (Queensland, University, Brisbane, Australia) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-14, Mar.-Apr. 1984, p. 304-310. refs

Mathematical (growth curve, stochastic and regression) models in pure and modified forms are compared in view of their performance on the question of maximum aircraft speeds by the year 2000. Attention is given to the models' different mathematical features and incorporation of historical data. O.C.

A84-40767**STOCHASTIC VERSUS DETERMINISTIC APPROACH TO THE DESIGN OF THE CONTROL LAW OF MOVING FLIGHT SIMULATORS**

R. SIVAN and N. TALWAR (Technion - Israel Institute of Technology, Haifa, Israel) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-14, Mar.-Apr. 1984, p. 319-325. Research supported by the Technion - Israel Institute of Technology. refs

In this correspondence, the optimal control of the motion of moving flight simulators is presented as an optimal tracking problem, and two approaches are compared: a stochastic approach that makes use of the past of the airplane trajectory, and a deterministic approach that makes use of both the past and the future of the airplane trajectory. The tracking error is, in both cases, the discrepancy between the motion cues measured by the vestibular sensors in real flight and in simulated flight. It is shown that the deterministic approach leads to a significantly better performance than the stochastic approach, with respect to the minimization of the root mean square (RMS) tracking error, while the improvement with respect to the decrease of the maximum tracking error is moderate. Of course, there always remains the task of verifying the quality of the design using pilot ratings.

Author

A84-41645**STANDARD COMPUTER GRAPHIC OUTPUT USED AT N.P. LET, UHERSKE HRADISTE-KUNOVICE [STANDARDNI GRAFICKY POCITACOVY VYSTUP POUZIVANY V N.P. LET UHERSKE HRADISTE-KUNOVICE]**

S. TRNKA Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1984, p. 19-24. In Czech.

The utilization of the standard computer graphic output at the N.P. LET aeronautical institute is examined with attention given to the unified graphic file, and to the features and structure of the CL2 graphic file. The subroutine package generating the CL2 graphic file is discussed along with routines for the function control of graphic devices installed in the N.P. LET plant. B.J.

A84-41652**POSSIBILITIES OF THE SOFEM SYSTEM FROM THE VIEWPOINT OF DATA GENERATION [MOZNOSTI SYSTEMU SOFEM Z HLEDISKA GENERACE DAT]**

M. MECIAR Zpravodaj VZLU (ISSN 0044-5355), no. 2, 1984, p. 87-92. In Czech.

The paper examines input-data preparation for structural-strength analysis using the FEM-based SOFEM system. Emphasis is placed on data generation with regard to geometric and mechanical characteristics, boundary conditions, and the loading of idealized structures. The possibility of data generation is demonstrated on simple examples. B.J.

A84-41658**DEVELOPMENT OF EMPIRICAL MODELS ON THE BASIS OF REGRESSION METHODS AND THEIR APPLICATION IN AVIATION [TVORBA EMPIRICKYCH MODELU REGRESNIMI METODAMI A JEJICH APLIKACE V LETECTVI]**

K. KVETON and J. KVARDA Zpravodaj VZLU (ISSN 0044-5355), no. 3, 1984, p. 153-157. In Czech. refs

Some basic regression methods are described from the point of view of statistical assumptions, computational algorithms, and practical application. Attention is then given to the use of regression methods for the determination of the parameters of dynamic systems. As an example, numerical results are presented for the longitudinal motion of an aircraft when the appropriate characteristics are modeled by a function in the form of a rational fraction. B.J.

A84-41660**THE USE OF REGRESSION-ANALYSIS METHODS TO FORM COONS PATCHES [POUZITI METOD REGRESNI ANALYZY PRI TVORBE COONSOVYCH PLATU]**

B. KVETONOVA Zpravodaj VZLU (ISSN 0044-5355), no. 3, 1984, p. 165-169. In Czech.

Methods for the automatic determination of the boundary curves of Coons patches are examined. Plane boundary curves are regressively plotted in such a way that the geometric form of the curve agrees with the given requirements. This can be achieved by an appropriate choice of a subset of models of the required geometrical properties; a model with the optimal statistical properties is automatically chosen from this subset. Although regression models are nonlinear with respect to the parameters, they can be made linear by a suitable transformation, making possible a rapid reliable numerical solution. Appropriate bilinear, bicubic, and biquintic patches can be reduced to boundary curves chosen in this manner. B.J.

A84-42301**AN ENGINEERING APPROACH TO TRANSIENT RESPONSE SENSITIVITY**

D. R. TOWILL (University of Wales Institute of Science and Technology, Cardiff, Wales) Radio and Electronic Engineer (ISSN 0033-7722), vol. 54, March 1984, p. 121-128. refs

The history of the development of techniques for predicting the transient response sensitivity of SISO feedback control systems to plant changes is reviewed, beginning with an analog approach and leading to the state of the art. It is shown that for a given transient response performance specification, significant reductions

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in sensitivity can be achieved in conventional systems by including feedback concentrations. This methodology is applied to other high-order systems via low-order models, and the problem of parameter tolerance is used to illustrate the method. Some transient response sensitivity functions are used to assess the relative merits of systems stabilized by sensor measurements. I.H.

A84-42339*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAXIMUM LIKELIHOOD ALGORITHM USING AN EFFICIENT SCHEME FOR COMPUTING SENSITIVITIES AND PARAMETER CONFIDENCE INTERVALS

P. C. MURPHY (NASA, Langley Research Center, Hampton, VA) and V. KLEIN (Joint Institute for Advancement of Flight Sciences, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 131-139. refs
(AIAA PAPER 84-2084)

Improved techniques for estimating airplane stability and control derivatives and their standard errors are presented. A maximum likelihood estimation algorithm is developed which relies on an optimization scheme referred to as a modified Newton-Raphson scheme with estimated sensitivities (MNRES). MNRES determines sensitivities by using slope information from local surface approximations of each output variable in parameter space. The fitted surface allows sensitivity information to be updated at each iteration with a significant reduction in computational effort compared to integrating the analytically-determined sensitivity equations or using a finite difference scheme. An aircraft estimation problem is solved using real flight data to compare MNRES with the commonly used modified Newton-Raphson technique; MNRES is found to be faster and more generally applicable. Parameter standard errors are determined using a random search technique. The confidence intervals obtained are compared with Cramer-Rao lower bounds at the same confidence level. It is observed that the nonlinearity of the cost function is an important factor in the relationship between Cramer-Rao bounds and the error bounds determined by the search technique. Author

A84-42368#
USE OF AIR COMBAT SIMULATION FOR CALCULATION OF COMBAT ALLOWANCES

D. T. JOHNSON (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Atmospheric Flight Mechanics Conference, Seattle, WA, August 21-23, 1984, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1984, p. 441-448. refs
(AIAA PAPER 84-2127)

The potential of using multiple-vehicle air combat simulation on a digital computer to calculate combat sensitivity, combat time, and fuel allowance is explored. The factors investigated were: the effect of force size, the effect of being outnumbered, the effect of sensitivities to aircraft type and combat speed, the effect of reducing combat time, and the effect of maneuverability. For equal aircraft and force sizes, a strong correlation was found between force size and the length of the combat. It was also found that the addition of more and longer range missiles shortened the combat time and produced higher losses, an that when a side was outnumbered its effectiveness was reduced and the combat time shortened. Combat time and fuel usage increased as average combat speed increased. When initial missile shots were used, only small effectiveness gains due to increased aircraft maneuverability were found, and increased maneuverability had little effect on the combat time requirements. B.J.

N84-29494# SRI International Corp., Menlo Park, Calif.
DISTRIBUTED AVIONIC COMPUTERS Final Report
K. N. LEVITT, P. M. MELLAR-SMITH, and R. L. SCHWARTZ
Oct. 1983 88 p
(Contract N00019-82-C-0087)
(AD-A142140) Avail: NTIS HC A05/MF A01 CSCL 09B

The goal of the task described in this report is to establish the basis for an advanced fault-tolerant onboard computer that will be the successor to the current generation of fault-tolerant computers. Towards this goal we are working on the following technical problems: (1) The architecture of a network-based fault-tolerant system; (2) The diagnosis of transient faults from error reports; (3) The use of Ada as the language for the executives of the computer and the application programs; and (4) A new paradigm (an extension of the conventional voting paradigm) for comparing the values produced by replicated processors. GRA

N84-29500*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRODUCTION VERSION OF THE EXTENDED NASA-LANGLEY VORTEX LATTICE FORTRAN COMPUTER PROGRAM. VOLUME 2: SOURCE CODE

H. E. HERBERT (Computer Science Corp.) and J. E. LAMAR Apr. 1982 149 p refs
(NASA-TM-83304; NAS 1.15:83304) Avail: NTIS HC A07/MF A01 CSCL 09B

The source code for the latest production version, MARK IV, of the NASA-Langley Vortex Lattice Computer Program is presented. All viable subcritical aerodynamic features of previous versions were retained. This version extends the previously documented program capabilities to four planforms, 400 panels, and enables the user to obtain vortex-flow aerodynamics on cambered planforms, flowfield properties off the configuration in attached flow, and planform longitudinal load distributions. Author

N84-29556*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EFFICIENT APPROXIMATE FACTORIZATION IMPLICIT SCHEME FOR THE EQUATIONS OF GASDYNAMICS
T. J. BARTH (Informatics General Corp.) and J. L. STEGER Jun. 1984 35 p refs
(NASA-TM-85957; A-9744; NAS 1.15:85957) Avail: NTIS HC A03/MF A01 CSCL 12A

An efficient implicit finite-difference algorithm for the gas dynamic equations utilizing matrix reduction techniques is presented. A significant reduction in arithmetic operations is achieved while maintaining the same favorable stability characteristics and generality found in the Beam and Warming approximate factorization algorithm. Steady-state solutions to the conservative Euler equations in generalized coordinates are obtained for transonic flows about a NACA 0012 airfoil. The theoretical extension of the matrix reduction technique to the full Navier-Stokes equations in Cartesian coordinates is presented in detail. Linear stability, using a Fourier stability analysis, is demonstrated and discussed for the one-dimensional Euler equations. It is shown that the method offers advantages over the conventional Beam and Warming scheme and can retrofit existing Beam and Warming codes with minimal effort. M.G.

N84-29572# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
AREA EQUIVALENT METHOD VISICALC (TRADE NAME). USERS' GUIDE
T. L. CONNOR and D. N. FORTESCUE Feb. 1984 34 p
(AD-A141430; FAA-EE-84-8) Avail: NTIS HC A03/MF A01 CSCL 12A

This document contains instructions to execute the Area Equivalent Method (AEM). The AEM requires the VISICALC software package and an Apple IIe personal computer or a calculator. The Area Equivalent Method is a mathematical process to calculate Day Night Average Sound Level contour area. The AEM is easy to use and is intended as a screening procedure to

determine the need for an airport Environmental Impact Statement. Author (GRA)

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PHYSICS

N84-29592# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

ALGORITHMS FOR ZONAL METHODS AND DEVELOPMENT OF THREE DIMENSIONAL MESH GENERATION PROCEDURES Final Report, Sep. 1980 - Aug. 1983

J. L. STEGER Wright-Patterson AFB, Ohio AFWAL Feb. 1984 97 p

(Contract F33615-81-K-3020; AF PROJ. 2307)

(AD-A141692; AFWAL-TR-83-3129) Avail: NTIS HC A05/MF A01 CSCL 12A

The goal of this research was to further develop zonal methods and three dimensional procedures for application of finite difference methods to solve complex aircraft configurations. For the task of three dimensional grid generation both elliptic and hyperbolic methods were developed. A chimera grid scheme, that is, the use of overset multiple grid systems, was also tested in two dimensions. In zonal methods several new algorithms were developed. These included combining transonic potential codes with thin layer Navier-Stokes equations, unsteady transonic potential, Euler and vector potential codes. This report summarizes the various numerical algorithms that were studied. Author (GRA)

N84-30742# Naval Postgraduate School, Monterey, Calif.
IMPROVEMENTS TO SOFTWARE MAINTENANCE METHODS IN REAL TIME EMBEDDED AVIATION FLIGHT SYSTEMS M.S. Thesis

R. B. UPCHURCH Dec. 1983 90 p

(AD-A141949) Avail: NTIS HC A05/MF A01 CSCL 09B

Software maintenance costs in Naval Aviation Operational Flight Programs (OFP) are very high and are projected to climb higher in the future. Maintenance costs are high due to poor initial design, limited programmer and system resources, poor documentation, the conditions under which the OFP must operate and the difficulty involved in performing meaningful flight software tests. The primary factors which produce the stated problems with aviation software systems are discussed. The maintenance phase of the software lifecycle model proposed for standard application software systems is contrasted with that for real time, embedded, aviation software systems. A limited set of software tools and methodologies which are currently available and would greatly aid the system engineers tasked with OFP maintenance is proposed. These tools and methodologies center on two areas of flight software maintenance; documentation and testing. The thesis concludes with recommendations for future aviation flight software systems.

Author (GRA)

N84-30774# Softech, Inc., Waltham, Mass.
INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM) ARCHITECTURE. PART 3, VOLUME 4: COMPOSITE INFORMATION MODEL OF DESIGN PRODUCT (DES 1) Final Report, Sep. 1980 - Oct. 1982

C. MARTIN and S. SMITH Wright-Patterson AFB, Ohio AFWAL Sep. 1983 195 p

(Contract F33615-80-C-5109)

(AD-A142447; REPT-1080-33-VOL-4; AFWAL-TR-82-4063-VOL-4)

Avail: NTIS HC A09/MF A01 CSCL 09B

The Integrated Computer Aided Manufacturing (ICAM) Architecture Part 3 was initiated to maintain and update the existing manufacturing architecture as well as develop training courses to assist in the transition of IDEF applications, concepts and procedures to other Air Force programs. This volume, Volume 4, presents the composite view depicting the design process as it exists today in the form of an 'AS IS' Information Model of Design. Author (GRA)

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A84-40599* Brown Univ., Providence, R. I.

SOUND GENERATED AERODYNAMICALLY REVISITED - LARGE-SCALE STRUCTURES IN A TURBULENT JET AS A SOURCE OF SOUND

R. MANKBADI and J. T. C. LIU (Brown University, Providence, RI) Royal Society (London), Philosophical Transactions, Series A (ISSN 0080-4614), vol. 311, no. 1516, June 14, 1984, p. 183-217. refs (Contract NSF MEA-78-22127; NAG1-379)

The theoretical capability of identifying the source of turbulent jet noise is assessed in comparison with experimental data. Account is taken of axisymmetric and spiral turbulence modes in Lighthill's (1952) formulation of turbulent noise. Coherent structures interacting with the mean flow and the fine-grained turbulence are the primary noise sources, modeled as an oscillating streamwise distribution. Low-frequencies arise farther downstream while high-frequencies congregate close to the nozzle lip. Previous measurements at various exit velocities, angles with respect to the nozzle axis, the Strouhal number and downstream distance are discussed. The model successfully predicted the angular distribution of noise frequency due to coherent structures. Further work is indicated on compressibility effects. M.S.K.

A84-40852*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

COMMENT ON 'DERIVATION OF THE FUNDAMENTAL EQUATION OF SOUND GENERATED BY MOVING AERODYNAMIC SURFACES

F. FARASSAT (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 22, Aug. 1984, p. 1183, 1184; Author's Reply, p. 1184. refs

A84-41038#

PULSE-RELATED INCREASE IN CONNECTION WITH THE EVALUATION OF FLIGHT NOISE [IMPULSZUSCHLAG BEI DER BEURTEILUNG VON FLUGLAERM]

R. PAULSEN (Medizinisches Institut fuer Umwelthygiene, Duesseldorf, West Germany) Deutsche Arbeitsgemeinschaft fuer Akustik, Gemeinschaftstagung, 10th, Darmstadt, West Germany, Mar. 26-29, 1984, Paper. 4 p. In German.

German specifications concerning the determination of the flight noise evaluation level consider an increase with respect to the value corresponding to the energy-equivalent steady sound level. These increases are to take into account pulse and tone effects. However, in comments regarding these specifications, it is stated that the increases are unnecessary because the limit value at which the pulse-related increases are to become effective is not quite reached in the case of airliners. The present investigation is concerned with a study of the actual situation existing in this case, taking into account a comprehensive data set obtained on the basis of flight noise measurements. It is found that pulse-related increases in the case of flight noise can reach values as high as 4 dBA. G.R.

A84-41039#

UNANSWERED QUESTIONS FROM THOSE AFFECTED BY AIRCRAFT NOISE TO SCIENCE AND REGULATION [OFFENE FRAGEN DER FLUGLAERMBETROFFENEN AN WISSENSCHAFT UND NORMUNG]

J. H. BECKERS (Bundesvereinigung gegen Fluglaerm, West Germany) Deutsche Arbeitsgemeinschaft fuer Akustik, Gemeinschaftstagung, 10th, Darmstadt, West Germany, Mar. 26-29, 1984, Paper. 4 p. In German. refs

Selected aspects of aircraft-noise measurement and control are reviewed from the perspective of the people affected. A number

of factors to be considered in evaluating the physiological and psychological effects of noise are listed, including the determination of absolute exposure levels, the effects of secondary noise sources, cumulative effects, sudden-onset and differential effects, and the increased susceptibility of particular populations. The (inappropriate) use of mean maximal sound levels based on 1 percent of the time period (L-1 values) in quantifying aircraft noise, the need for automatic measuring apparatus with the capability to recognize aircraft noise, and the desirability of an international noise parameter based on perceived levels are discussed. T.K.

A84-41130#

THE INFLUENCE OF SURFACE COMPLIANCE ON THE PRODUCTION OF SOUND BY A TURBULENT BOUNDARY LAYER

M. S. HOWE (Southampton, University, Southampton, England) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, July 1984, p. 383-388. refs

The theory of aerodynamic sound is applied to investigate the production of sound by turbulent boundary layer flow over a thin, flexible plate. Conventional theories of boundary layer noise attribute the radiation to the boundary layer quadrupoles and their (passive) images in the plate, and neglect the interaction of turbulence with the finite amplitude motion of the plate caused by the wall pressure fluctuations. This interaction generates sound whose intensity is characteristic of aerodynamic sources of dipole type. In (underwater) situations involving the high fluid loading of steel plates, it is shown that the intensity of the dipole noise may be comparable to that produced by the quadrupoles. The dipoles dominate the radiation from more compliant surfaces, of the type commonly used in experiments on compliant wall drag reduction, and it is suggested that the injudicious deployment of compliant wall coatings may result in the production of unacceptably high levels of aerodynamic noise. Author

A84-41132*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FINITE ELEMENT-INTEGRAL ACOUSTIC SIMULATION OF JT15D TURBOFAN ENGINE

K. J. BAUMEISTER (NASA, Lewis Research Center, Cleveland, OH) and S. J. HOROWITZ (USAF, Washington, DC) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, July 1984, p. 405-413. refs

An iterative finite element integral technique is used to predict the sound field radiated from the JT15D turbofan inlet. The sound field is divided into two regions: the sound field within and near the inlet which is computed using the finite element method and the radiation field beyond the inlet which is calculated using an integral solution technique. The velocity potential formulation of the acoustic wave equation was employed in the program. For some single mode JT15D data, the theory and experiment are in good agreement for the far field radiation pattern as well as suppressor attenuation. Also, the computer program is used to simulate flight effects that cannot be performed on a ground static test stand. Author

A84-42553

VIBRATIONAL STABILIZATION OF THE LAGRANGE TOP [O VIBRATSIONNOI STABILIZATSII VOLCHKA LAGRANZHA]

G. M. ROZENBLAT Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 48, May-June 1984, p. 370-375. In Russian.

The problem of the stabilization of the Lagrange top with the aid of periodic rotations of its rotor is considered. The rotation occurs in such a manner that the rotation angle of the rotor about its own axis is, on the average, equal to zero. Sufficient conditions for the stabilization of the top are derived, and controls implementing the stabilization are examined. The proposed stabilization method is compared with that for an inverted pendulum. B.J.

N84-29466*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DEFINITIONS OF NOISE AND NOISE POLLUTION

In its Physiol., Psychol., and Social Effects of Noise p 1-3 Jul. 1984 refs

Avail: NTIS HC A99/MF A01 CSCL 20A

The definitions of noise and noise pollution are examined with emphasis on the psychological, physiological, sociological and economic impacts on personnel and the environment. M.A.C.

N84-29477*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

GUIDELINES FOR ASSESSMENT AND CONTROL OF NOISE

In its Physiol., Psychol., and Social Effects of Noise p 607-646 Jul. 1984 refs

Avail: NTIS HC A99/MF A01 CSCL 20A

There is an obvious need for guidelines and standards with respect to what intensities and durations of noise exposure is considered incompatible with the health and well-being of the people exposed. These guidelines would presumably be useful for the zoning of land areas to avoid overexposure of people to environmental noise and for legislative-judicial adjudication of liabilities for possible damages to individuals and groups from exposure to noise. A number of guidelines for noise exposure were promulgated by various governmental agencies for these purposes. Partly because of the need for an integrated and consistent program of noise control for all elements of the government, the United States Environmental Protection Agency (EPA) was established. In addition to previously issuing some specific documents regarding safe noise exposure limits, the EPA joined several Federal operating and regulatory agencies in issuing guidelines for considering noise in land use planning and control. Government guideline documents, as well as some issued by non-government agencies, are examined. Also, newly proposed guidelines for noise in residential areas, and the scientific basis for these guidelines, are presented. Author

N84-29661*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.

FREE JET FEASIBILITY STUDY OF A THERMAL ACOUSTIC SHIELD CONCEPT FOR AST/VCE APPLICATION: SINGLE STREAM NOZZLES Final Report

R. K. MAJJIGI, J. F. BRAUSCH, B. A. JANARDAN, T. E. Balsa, P. R. KNOTT, and N. PICKUP Washington NASA Jul. 1984 354 p refs

(Contract NAS3-22137)

(NASA-CR-3758; E-2132; NAS 1.26:3758; R82AEB494) Avail:

NTIS HC A16/MF A01 CSCL 20A

A technology base for the thermal acoustic shield concept as a noise suppression device for single stream exhaust nozzles was developed. Acoustic data for 314 test points for 9 scale model nozzle configurations were obtained. Five of these configurations employed an unsuppressed annular plug core jet and the remaining four nozzles employed a 32 chute suppressor core nozzle. Influence of simulated flight and selected geometric and aerodynamic flow variables on the acoustic behavior of the thermal acoustic shield was determined. Laser velocimeter and aerodynamic measurements were employed to yield valuable diagnostic information regarding the flow field characteristics of these nozzles. An existing theoretical aeroacoustic prediction method was modified to predict the acoustic characteristics of partial thermal acoustic shields. B.G.

N84-29662*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ROTORCRAFT NOISE

R. J. HUSTON, comp. Washington Jul. 1982 424 p refs Proc. of the NASA/US Helicopter Ind. Workshop on Aerodyn. Noise Prediction/Noise Reduction, Hampton, Va., 29-31 Mar. 1982

(NASA-CP-2234; L-15408; NAS 1.55:2234) Avail: NTIS HC A18/MF A01 CSCL 20A

The establishment of a realistic plan for NASA and the U.S. helicopter industry to develop a design-for-noise methodology,

including plans for the identification and development of promising noise reduction technology was discussed. Topics included: noise reduction techniques, scaling laws, empirical noise prediction, psychoacoustics, and methods of developing and validating noise prediction methods.

N84-29663*# Sikorsky Aircraft, Stratford, Conn. Aeromechanics Branch.

ACOUSTIC DESIGN CRITERIA AND VALIDATION

P. ARCIDIACONO /in NASA. Langley Research Center Rotorcraft Noise p 5-32 Jul. 1982

Avail: NTIS HC A18/MF A01 CSCL 20A

The tools currently available for acoustic design risk reduction and problem solving are limited in accuracy and do not encompass all design parameters. Assuming available technology, designing helicopters to confidently meet noise limits as were proposed by the FAA and were now adopted by ICAO will result in significant design compromises. Author

N84-29664*# Bell Helicopter Co., Fort Worth, Tex. Acoustics Dept.

NOISE REDUCTION TECHNIQUES: CRITERIA AND VALIDATION

J. M. DREES /in NASA. Langley Research Center Rotorcraft Noise p 33-43 Jul. 1982

Avail: NTIS HC A18/MF A01 CSCL 20A

Modification of proposed rules and regulations to provide operational flexibility and address derivations were investigated. Prediction capabilities to meet the roles need to be improved. A historical overview of current problems was reviewed in the light of past history. B.G.

N84-29666*# Hughes Helicopters, Culver City, Calif.

NOISE REDUCTION EXPERIENCE AT HUGHES HELICOPTER, INC.

D. S. JANAKIRAM /in NASA. Langley Research Center Rotorcraft Noise p 63-84 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

Noise reduction is mostly limited to light helicopters whose noise signature is dominated by their tail rotors. It is primarily hardware oriented. Well known noise reduction techniques such as reduction of rotor speeds with an accompanying increase in solidity to maintain performance, engine noise reduction with the use of exhaust mufflers, and acoustic blanketing of transmission and engine compartment are used. The concept of blade phasing as a means of reducing tail rotor noise is also used. Engine noise (exhaust noise), power train noise and airframe noise becomes important at low rotor tip speeds and means must be found to reduce these noise sources if further noise reductions are desired. The use of a special test rig aids in isolating the various noise sources and arriving at the penalties (performance or payload) involved in quieting them. Significant noise reduction is achieved for the light helicopter with minimum performance or weight penalties because of the dominance of a single noise source (the tail rotor). M.A.C.

N84-29667*# Boeing Vertol Co., Philadelphia, Pa.

BOEING VERTOL NOISE REDUCTION EXPERIENCE

W. W. WALLS /in NASA. Langley Research Center Rotorcraft Noise p 85-96 Jul. 1982

Avail: NTIS HC A18/MF A01 CSCL 20A

Boeing Vertol Model 234, CH-47D and 347 tandem rotor helicopters demonstrate noise levels that comply with the overall noise standard requirements. The helicopters achieve these noise levels because they are, by design, free of impulsive noise in level flight and climb. Avoiding an impulsive noise signature is achieved by developing and applying configuration design criteria that eliminate blade vortex intersections and recognize advancing blade tip noise limitations in high speed forward flight. Airfoil design, rotor separation and rotor tip speed selection all contribute to the noise control. Compliance with the approach element of the standards is marginal at best. The approach problem is not appreciably alleviated by reduced tip speed and airfoil design. Since

it is a single rotor phenomenon, it is not alleviated by rotor separation in the tandem configuration. Tip shapes may provide the answer, but to date this approach has not led to a satisfactory solution. M.A.C.

N84-29668*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ROTARY WING AERODYNAMICALLY GENERATED NOISE

F. J. SCHMITZ and H. A. MORSE /in NASA. Langley Research Center Rotorcraft Noise p 97-106 Jul. 1982 refs Prepared in cooperation with the Army Aeromechanics Lab., Moffett Field, Calif.

Avail: NTIS HC A18/MF A01 CSCL 20A

The history and methodology of aerodynamic noise reduction in rotary wing aircraft are presented. Thickness noise during hover tests and blade vortex interaction noise are determined and predicted through the use of a variety of computer codes. The use of test facilities and scale models for data acquisition are discussed. M.A.C.

N84-29669*# Army Structures Lab., Hampton, Va.

NASA/ARMY SUPPORTED NOISE SOURCE/NOISE REDUCTION PROGRAMS AT LANGLEY

D. R. HOAD /in NASA. Langley Research Center Rotorcraft Noise p 107-122 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

The helicopter noise research related to noise source mechanism identification and reduction includes many of the critical noise problems experienced by the helicopter. These include blade vortex interaction (BVI) noise, broadband turbulence ingestion noise, rotor blade self noise including trailing edge effects, model scale effects evaluations, and to some degree main rotor/tail rotor interaction noise. Issues that arise from this evaluation are; (1) Broadband noise can be a significant contribution to the overall noise problem. (2) Scale model investigations are an effective means of conducting helicopter noise research; however, more model/flight correlation studies are required to develop a high degree of confidence of the use of scale model results in the design process of helicopters. (3) More detailed investigations identifying critical factors affecting the main rotor/tail rotor noise mechanism are required. M.A.C.

N84-29670*# Boeing Vertol Co., Philadelphia, Pa.

ROLE OF EMPIRICAL METHODS

H. STERNFELD /in NASA. Langley Research Center Rotorcraft Noise p 123-146 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

There are different levels of helicopter noise prediction which may be appropriate at various stages in the design process. In the early preliminary design stages, when available information is usually limited to parameters such as gross weight, tip speed, forward speed, rotor radius, and possibly number of blades, one is limited to purely empirically based methodology. As the design progresses, and airfoil blade planforms and twists are defined, predictions of airloads, vortex paths, and compressibility effects may permit application of more analytically based sound pressure level prediction methods. At the present stage of development of first principle prediction methodology, however, the designer may still find it necessary to supplement such analyses with modifications based on empirical experience. Various causes and parameters of helicopter noise were identified and discussed from the standpoint of prediction. Rotational noise, blade-vortex interaction noise, thickness noise, broadband noise, and flyover noise were considered. A modular computer program for helicopter noise prediction (HELNOP) was described briefly. Wind tunnel models as useful tools in predicting full scale helicopter noise were also discussed. R.S.F.

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N84-29671*# Hughes Helicopters, Culver City, Calif.

PRIORITY FOR EMPIRICAL METHODS DEVELOPMENT

R. J. KING *In* NASA. Langley Research Center Rotorcraft Noise p 147-169 Jul. 1982

Avail: NTIS HC A18/MF A01 CSCL 20A

Several noise sources combine to make up the total helicopter noise spectrum. The sources that are most important to community annoyance are the tail rotor (discrete), main rotor (unsteady), and engine (unsteady). The periodic and broadband noise components of the helicopter rotor were enumerated, and an approach to rotorcraft noise prediction was discussed. Helicopter noise sources were prioritized, and design improvements to reduce noise were reviewed. Main rotor noise is believed to be the key to quieter helicopters since there are proven and relatively inexpensive ways to handle the tail rotor. Blade Vortex Interaction (BVI) noise is a problem to some extent with all helicopters, particularly in the descent mode. Methodology must be developed to allow forecast and control of this type of noise. Additional means of controlling it, such as reduced rotor speeds for terminal operations should also be pursued because they may be the most effective means of control and they apply to all helicopter models. Main rotor broadband noise is the limiting factor in overall helicopter noise generation. Development of semi-empirical methods to predict its behavior is necessary if results are to be achieved in the short time period available. R.S.F.

N84-29672*# United Technologies Research Center, East Hartford, Conn. Aeroacoustics Group.

FACILITY REQUIREMENTS FOR HELICOPTER NOISE RESEARCH

R. H. SCHLINKER and D. R. HOAD (Army Structures Lab., Hampton, Va.) *In* NASA. Langley Research Center Rotorcraft Noise p 171-202 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

Development of future helicopter noise prediction methods requires an accurate experimental data base for correlation studies or assessment of theoretical prediction methods. The aerodynamic and acoustic performance criteria for conducting experimental studies of helicopter noise using existing test facilities were defined. Requirements for ground-based facilities were described in addition to the limitations associated with full scale and model scale studies. Flight testing methods were also evaluated briefly and the restrictions associated with these approaches were cited. Finally, a general evaluation of ground-based and flight testing methods is given. Based on this presentation, future investigators can select the experimental approach best suited for generating a desired data base. Also, facility improvements need to extend the state of the art in helicopter noise experimental studies so that problems can be identified. Author

N84-29673*# Bell Helicopter Co., Fort Worth, Tex. Acoustics Dept.

HIGH-SPEED NOISE OF HELICOPTER ROTORS

K. R. SHENOY *In* NASA. Langley Research Center Rotorcraft Noise p 203-218 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

Various parameters of helicopter rotor noise were considered. Impulsive noise, flow regions of a helicopter rotor, noise prediction, aspect ratio, blade tip shape and speed, and blade-vortex interaction noise were among the topics addressed. Recommendations were also given. R.S.F.

N84-29674*# Sikorsky Aircraft, Stratford, Conn. Acoustics Section.

ACOUSTIC METHODOLOGY REVIEW

R. G. SCHLEGEL *In* NASA. Langley Research Center Rotorcraft Noise p 219-244 Jul. 1982

Avail: NTIS HC A18/MF A01 CSCL 20A

It is important for industry and NASA to assess the status of acoustic design technology for predicting and controlling helicopter external noise in order for a meaningful research program to be formulated which will address this problem. The prediction methodologies available to the designer and the acoustic engineer

are three-fold. First is what has been described as a first principle analysis. This analysis approach attempts to remove any empiricism from the analysis process and deals with a theoretical mechanism approach to predicting the noise. The second approach attempts to combine first principle methodology (when available) with empirical data to formulate source predictors which can be combined to predict vehicle levels. The third is an empirical analysis, which attempts to generalize measured trends into a vehicle noise prediction method. This paper will briefly address each. B.W.

N84-29675*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PSYCHOACOUSTIC CONSIDERATIONS FOR HELICOPTER NOISE QUANTIFICATION: METRICS, HUMAN RESPONSE AND CRITERIA

C. A. POWELL *In* its Rotorcraft Noise p 245-260 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

The purpose of this paper is to examine several aspects of helicopter noise quantification from the standpoint of psychoacoustics. Noise metrics in common use to describe far-field aircraft noise and the noise characteristics which they consider are discussed. Some findings of recent psychoacoustic research related specifically to helicopter noise quantification are presented. Criteria for the accuracy of noise metrics to quantify helicopter noise are discussed. Finally, the prospects for improved metrics and research needed to develop and validate improved metrics or existing metrics are discussed. B.W.

N84-29676*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HELICOPTER ENGINE CORE NOISE

U. H. VONGLAHN *In* NASA. Langley Research Center Rotorcraft Noise p 261-284 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

Calculated engine core noise levels, based on NASA Lewis prediction procedures, for five representative helicopter engines are compared with measured total helicopter noise levels and ICAO helicopter noise certification requirements. Comparisons are made for level flyover and approach procedures. The measured noise levels are generally significantly greater than those predicted for the core noise levels, except for the Sikorsky S-61 and S-64 helicopters. However, the predicted engine core noise levels are generally at or within 3 dB of the ICAO noise rules. Consequently, helicopter engine core noise can be a significant contributor to the overall helicopter noise signature. Author

N84-29677*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ROTORCRAFT NOISE PREDICTION

W. E. ZORUMSKI *In* its Rotorcraft Noise p 291-308 Jul. 1982 refs

Avail: NTIS HC A18/MF A01 CSCL 20A

The purpose of this presentation is to give a general strategy for rotorcraft noise prediction. This strategy is expressed through a modular software system design rather than theoretical analysis of the aerocoustic phenomena. The crucial design choices in a software system design are the module interface definitions. An interface is the data that are passed from one module to another. A module takes data from one (input) interface and transforms it, through a prediction method, to another (output) interface. In system design, the method is less important than the interface. The two types of methods available may be broadly classified as empirical or analytical, although no method is purely one or the other. These two general approaches will be compared as they apply to rotorcraft noise prediction. Author

N84-29678*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ROTOR NOISE PREDICTION TECHNOLOGY: THEORETICAL APPROACH

F. FARASSAT *In its* Rotorcraft Noise p 309-318 Jul. 1982
 Avail: NTIS HC A18/MF A01 CSCL 20A

Helicopter rotors which are the most complicated noise generators among rotating blade machinery are discussed. The main or the tail rotor can be the dominant source of noise depending on the range of frequencies and the observer position. Significant advances in noise prediction were made. Acoustic analysis is the most successful and general theoretical method to treat the acoustics of helicopter noise. The aerodynamic approach is used to study nonlinear acoustic effects. The results of acoustic analogy depend greatly on the input data. E.A.K.

N84-29679*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT VERSUS THEORY

F. H. SCHMITZ, Y. H. YU, and D. A. BOXWELL *In* NASA. Langley Research Center Rotorcraft Noise p 319-330 Jul. 1982 refs Prepared in cooperation with Army Armament Research and Development Command, Moffett Field, Calif.
 Avail: NTIS HC A18/MF A01 CSCL 20A

High speed compressibility noise and vortex interaction noise, which are aerodynamically generated noise sources, were investigated. Noise generating mechanisms were identified. Linear and nonlinear theory were compared and are in agreement with data on amplitude and wave forms. The interaction area between the acoustic planform and blade/vortex interaction lines are examined. E.A.K.

N84-29680*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC PREDICTION I

W. JOHNSON *In* NASA. Langley Research Center Rotorcraft Noise p 331-356 Jul. 1982 refs
 Avail: NTIS HC A18/MF A01 CSCL 20A

The aerodynamic prediction methodology which is needed for rotor noise calculations is presented. Airloads and wakes, dynamic stall, compressible flow, and random loads are reviewed. The aerodynamics/acoustics interface is defined when the noise or measurements are considered. The classical approach involving a distinct separation of aerodynamic sources and acoustic propagation is the basis of most rotor noise calculations. Aeroacoustics of rotors involve unique features which are not encountered in other aerodynamic problems of rotors: (1) acoustics problems ultimately require only an order of magnitude estimate of the sound pressure field, consequently remarkably good noise predictions are obtained from very simple aerodynamic analyses; (2) aeroacoustics introduce an interest in the higher frequency aerodynamics, the deterministic aerodynamic phenomena are still low frequency, however, the high frequency noise comes from the acoustic propagation; and (3) the aerodynamic phenomena on rotors that are only of interest due to the noise they produce, are the random aerodynamic pressures on the blades. E.A.K.

N84-29681*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC PREDICTIONS II

M. E. TAUBER *In* NASA. Langley Research Center Rotorcraft Noise p 357-373 Jul. 1982 refs
 Avail: NTIS HC A18/MF A01 CSCL 20A

The development of technology to aid in the design of advanced rotor blades to improve both aerodynamic and acoustic performance is discussed. The development of advanced computer codes to calculate the subsonic and transonic flow field about rotor blades and to model such high noise producing phenomena as shock waves and blade/vortex interaction is examined. The codes are verified by comparison with experimental data. Making the codes available to industry and to provide some training for the industrial users is emphasized. E.A.K.

N84-29682*# Sikorsky Aircraft, Stratford, Conn. Acoustics Dept.

STATE OF THE ART: DESIGN FOR NOISE I

D. S. JENNY *In* NASA. Langley Research Center Rotorcraft Noise p 375-395 Jul. 1982
 Avail: NTIS HC A18/MF A01 CSCL 20A

The engineering management strategy involved in designing helicopters to meet a noise requirement is discussed. A different perspective is given on how designs were accomplished in the past, how a new design would be carried out today, and how knowledge gained through acoustics R&D will have two important effects. It will lead to invention of quieter features to be incorporated, and it will improve the ability to predict accurately the noise levels of new designs before they are built. Each of these effects changes the basic design process. R.J.F.

N84-29683*# Bell Helicopter Co., Fort Worth, Tex. Acoustics Dept.

STATE OF THE ART: DESIGN FOR NOISE II

C. R. COX *In* NASA. Langley Research Center Rotorcraft Noise p 397-404 Jul. 1982
 Avail: NTIS HC A18/MF A01 CSCL 20A

Charts relating to helicopter noise reduction design efforts are given. Information regarding priorities, design guidelines, design margins, risks, noise prediction, derivative trends, design impact, and cost impact is given. R.J.F.

N84-29684*# Hughes Helicopters, Culver City, Calif.

A DESIGNER'S VIEWPOINT: REQUIREMENTS FOR REDUCING HELICOPTER NOISE

E. E. COHEN *In* NASA. Langley Research Center Rotorcraft Noise p 405-413 Jul. 1982
 Avail: NTIS HC A18/MF A01 CSCL 20A

Functional requirements of helicopter noise reduction are discussed from the work environment point by view, i.e., what conditions must exist before the designer can take aim, without too many restraints, at reducing noise, community demand for noise reduction, regulatory requirements, competition, and penalties are among the topics discussed. R.J.F.

N84-29685*# Kansas Univ., Lawrence. Flight Research Lab.

GENERAL AVIATION AIRCRAFT INTERIOR NOISE PROBLEM: SOME SUGGESTED SOLUTIONS

J. ROSKAM and R. NAVANEETHAN Jun. 1984 488 p refs (Contract NCCI-6)
 (NASA-CR-173784; NAS 1.26:173784; KU-FRL-417-23) Avail: NTIS HC A21/MF A01 CSCL 20A

Laboratory investigation of sound transmission through panels and the use of modern data analysis techniques applied to actual aircraft is used to determine methods to reduce general aviation interior noise. The experimental noise reduction characteristics of stiffened flat and curved panels with damping treatment are discussed. The experimental results of double-wall panels used in the general aviation industry are given. The effects of skin panel material, fiberglass insulation and trim panel material on the noise reduction characteristics of double-wall panels are investigated. With few modifications, the classical sound transmission theory can be used to design the interior noise control treatment of aircraft. Acoustic intensity and analysis procedures are included. M.A.C.

N84-29687*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

PROPELLER AIRCRAFT INTERIOR NOISE MODEL

L. D. POPE, E. G. WILBY, and J. F. WILBY Jul. 1984 158 p refs (Contract NAS1-15782)
 (NASA-CR-3813; NAS 1.26:3813; BBN-5058) Avail: NTIS HC A08/MF A01 CSCL 20A

An analytical model was developed to predict the interior noise of propeller-driven aircraft. The fuselage model is that of a cylinder with a structurally-integral floor. The cabin sidewall is stiffened by stringers and ring frames, and the floor by longitudinal beams. The cabin interior is covered with a sidewall treatments consisting

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of layers of porous material and an impervious trim septum. Representation of the propeller pressure field is utilized as input data in the form of the propeller noise signature at a series of locations on a grid over the fuselage structure. Results obtained from the analytical model are compared with test data measured by NASA in a scale model cylindrical fuselage excited by a model propeller. Author

N84-29692# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

SIMULATION PROCEDURE FOR THE CALCULATION OF AIRCRAFT NOISE [SIMULATIONSVERFAHREN ZUR BERECHNUNG VON FLUGLAERM]

O. BSCHORR, H. MELZER, and R. WOELK 1983 4 p

Avail: NTIS HC A02/MF A01

A procedure for the calculation of aircraft noise, especially of noise distributions at airports, was developed. The air traffic is directly simulated in the computer. Flight trajectories are discretized in a close meshed series of emission points to calculate noise evolution. Aircraft directional characteristics and meteorological conditions, especially ray curvature due to wind and temperature gradients, are taken into account. This procedure gives a real time histogram of the noise, comparable to an in situ measurement. Author (ESA)

N84-29693# Southampton Univ. (England). Inst. of Sound and Vibration Research.

ACTIVITIES REPORT OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH Annual Report, Mar. 1984

Mar. 1984 47 p refs

Avail: NTIS HC A03/MF A01

Research concerning noise and vibration control, automotive engineering design, auditory communication and hearing conservation, and structural shock analysis is described. Author (ESA)

N84-30886*# Lord Corp., Erie, Pa.

ACTIVE ATTENUATION OF PROPELLER BLADE PASSAGE NOISE

J. M. ZALAS and J. TICHY Jul. 1984 86 p refs

(Contract NAS1-17231)

(NASA-CR-172386; NAS 1.26:172386) Avail: NTIS HC A05/MF A01 CSDL 20A

Acoustic measurements are presented to show that active cancellation can be used to achieve significant reduction of blade passage noise in a turboprop cabin. Simultaneous suppression of all blade passage frequencies was attained. The spatial volume over which cancellation occurred, however, is limited. Acoustic intensity maps are presented to show that the acoustic input to the fuselage was sufficiently non-localized so as to require more judicious selection of cancellation speaker location. Author

N84-30887*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE INFLUENCE OF A WIND TUNNEL ON HELICOPTER ROTATIONAL NOISE: FORMULATION OF ANALYSIS

M. MOSHER Jul. 1984 30 p refs

(NASA-TM-85982; A-9815; NAS 1.15:85982) Avail: NTIS HC A03/MF A01 CSDL 20A

An analytical model is discussed that can be used to examine the effects of wind tunnel walls on helicopter rotational noise. A complete physical model of an acoustic source in a wind tunnel is described and a simplified version is then developed. This simplified model retains the important physical processes involved, yet it is more amenable to analysis. The simplified physical model is then modeled as a mathematical problem. An inhomogeneous partial differential equation with mixed boundary conditions is set up and then transformed into an integral equation. Details of generating a suitable Green's function and integral equation are included and the equation is discussed and also given for a two-dimensional case. Author

N84-30888*# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

EXPERIMENTAL STUDY OF NOISE TRANSMISSION INTO A GENERAL AVIATION AIRCRAFT

R. VAICAITIS, D. A. BOFILIOS, and R. EISLER Jun. 1984 153 p refs

(Contract NSG-1450)

(NASA-CR-172357; NAS 1.26:172357) Avail: NTIS HC A08/MF A01 CSDL 20A

The effect of add-on treatments on noise transmission into a cabin of a light aircraft was studied under laboratory conditions for diffuse and localized noise inputs. Results indicate that stiffening skin panels with honeycomb would provide on the average 3dB to 7 dB insertion loss over the most of selected frequency range H1 to 1000 Hz. Addition of damping tape on top of the honeycomb treatment increases insertion loss by 2dB to 3dB. Porous acoustic blankets show no attenuation of transmitted noise for frequencies below 300 Hz. Insertion of impervious vinyl septa between the layers of porous acoustic blankets do not provide additional noise reduction for frequencies up to about 500 Hz. Similar behavior was observed for noise barriers composed of urethane elastomer, decoupler foam and acoustic foam. A treatment composed from several layers of acoustic foams does not increase noise attenuation for the entire frequency range studied. An acoustic treatment composed of honeycomb panels, constrained layer damping tape, 2 to 3 inches of porous acoustic blankets, and limtrim which is isolated from the vibrations of the main fuselage structure seems to provide the best option for noise control. A.R.H.

N84-30898# National Aerospace Lab., Amsterdam (Netherlands). Flight Mechanics Div.

INSTRUMENTATION FOR IN-FLIGHT ACOUSTIC MEASUREMENTS IN AN ENGINE INTAKE

S. S. VANLEEUEWEN and I. ZANDBERGEN 16 Sep. 1983 9 p refs Presented at 2nd AIAA/AHS/IES/SETP/SFTE Flight Testing Conf., Las Vegas, Nev., 16-18 Nov. 1983

(Contract NIVR-1896)

(NLR-MP-83060-U) Avail: NTIS HC A02/MF A01

Acoustic measurements were carried out in the engine intake ducts of the Fokker F28 test aircraft during flight. One of the low bypass ratio engines with a hard walled intake was instrumented to detect the circumferential modes of the sound field. Aerodynamic measurements were carried out to determine the flow conditions in the intake near the wall. In the other engine the impedance of the inlet acoustic liner was measured. An error analysis of the instrumentation is given. It is concluded that the in-flight measurement of acoustic pressure ratios with an accuracy of 4.08% and 2.61 deg., and the measurement of stationary pressure with an accuracy of 0.55% is feasible. Author (ESA)

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A84-40119

COST EFFECTIVENESS OF CARGO TRANSPORT BY AIR [EKONOMICHESSKAIA EFFEKTIVNOST' PEREVOZOK GRUZOV VOZDUSHNYM TRANSPORTOM]

S. A. SARKISIAN, E. S. MINAEV, and P. A. NECHAEV Moscow, Izdatel'stvo Transport, 1984, 169 p. In Russian. refs

Current trends in the development of cargo transport by air in the Soviet Union and abroad are reviewed. The main trends in the development of cargo aircraft and ground facilities, airfreight networks, and types of cargo carried by aircraft are analyzed in

comparison with other kinds of cargo transport. The cost effectiveness of cargo transport by air is assessed, and the most effective applications are discussed. V.L.

A84-42686

CANADIAN SYMPOSIUM ON AIR CUSHION TECHNOLOGY, 17TH, OTTAWA, CANADA, OCTOBER 4-6, 1983, PREPRINTS

Symposium sponsored by the Canadian Aeronautics and Space Institute and Hovercraft Society. Ottawa, Canadian Aeronautics and Space Institute, 1983, 103 p. For individual items see A84-42687 to A84-42690.

Concepts and innovation, analysis and experiment, design and development, and operations and economics in air cushion technology are discussed. The topics addressed include: review of NASA ACLS research, simulation of air cushion heave dynamics with vent valve relay control, experiment on active control of air cushion heave dynamics, sailrail industrial application update, and heave stiffness hysteresis measurements on a large scale air cushion. Also discussed are: membrane ice model of high speed air cushion icebreaking, design and construction of light overcraft for use in coastal and exposed environments, Wartsila new generation air cushion vehicles, segmented air track amphibious all-purpose all-terrain vehicle. C.D.

A84-42688

SIMULATION OF AIR CUSHION HEAVE DYNAMICS WITH VENT VALVE RELAY CONTROL

J. R. AMYOT (National Research Council, Ottawa, Canada) IN: Canadian Symposium on Air Cushion Technology, 17th, Ottawa, Canada, October 4-6, 1983, Preprints. Ottawa, Canadian Aeronautics and Space Institute, 1983, p. 27-32.

A hybrid computer model of the heave dynamics of an air cushion with a segmented skirt and an automatic vent valve control system was used to investigate the effects of relay control threshold velocity on dynamic performance and make comparisons with proportional control. Results have shown that relay control can work well under certain conditions but proportional control is generally better. Author

N84-29805*# Garrett Turbine Engine Co., Phoenix, Ariz.

ADVANCED GAS TURBINE (AGT) Semiannual Progress Report, Jan. - Jun. 1983

Dec. 1983 78 p refs

(Contract DEN3-167)

(NASA-CR-174694; DOE/NASA/0167-7; NAS 1.26:174694; GARRETT-31-3725(7); SAPR-7) Avail: NTIS HC A05/MF A01 CSCL 13F

The development and progress of the Advanced Gas Turbine engine program is examined. An analysis of the role of ceramics in the design and major engine components is included. Projected fuel economy, emissions and performance standards, and versatility in fuel use are also discussed. M.A.C.

N84-31047*# National Aeronautics and Space Administration, Washington, D. C.

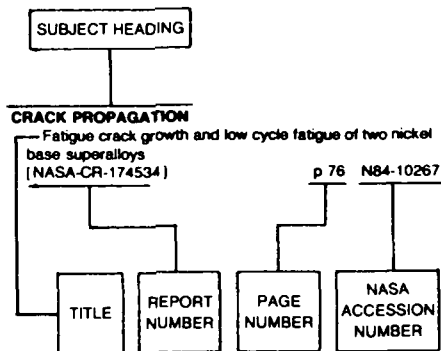
INDEX TO NASA NEWS RELEASES AND SPEECHES, 1983

1984 178 p

(NASA-TM-85509; NAS 1.15:85509) Avail: NTIS HC A09/MF A01 CSCL 05B

A listing is presented of 271 news releases distributed by the Office of Public Affairs, NASA Headquarters and 72 selected speeches given by Headquarters staff in 1983. Subject and personal name indexes are arranged alphabetically. Indexes to titles, news release numbers, and accession numbers are arranged numerically. A.R.H.

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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A-7 AIRCRAFT

Development of lateral-directional equivalent system models for selected U.S. Navy tactical aircraft
[AD-A141672] p 790 N84-28810

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Configuration design studies and wind tunnel tests of an energy efficient transport with a high-aspect-ratio supercritical wing [NASA-CR-3524] p 740 N84-28727

Results of design studies and wind tunnel tests of high-aspect-ratio supercritical wings for an energy efficient transport

[NASA-CR-159332] p 754 N84-28735

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Acoustic emission due to crack growth, crack face rubbing and structural noise in the CC-130 Hercules aircraft p 804 A84-40678

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Area equivalent method VISICALC (trade name). Users' guide [AD-A141430] p 814 N84-29572

NASA/Army supported noise source/noise reduction programs at Langley p 817 N84-29669

Instrumentation for in-flight acoustic measurements in an engine intake [NLR-MP-83060-U] p 820 N84-30898

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[NASA-CR-165631-VOL-2] p 789 N84-28803

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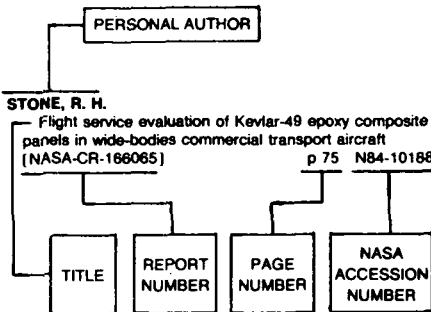
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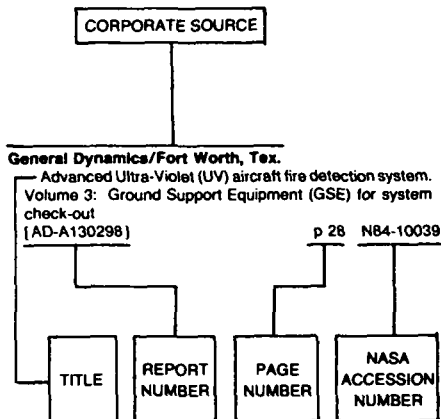
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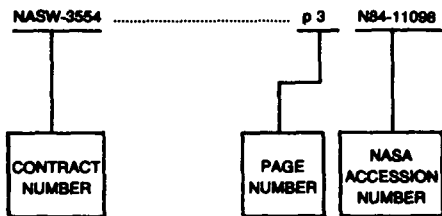
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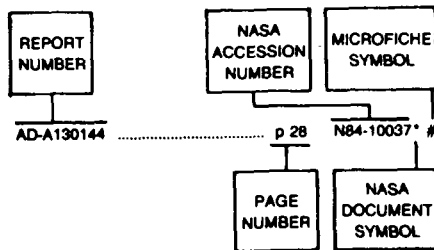
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AIAA PAPER 84-2161 p 769 A84-41335 * #
AIAA PAPER 84-2163 p 769 A84-41336 * #

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AIAA-84-2205	p 781	N84-28790	* #	E-2071	p 799	N84-28917	* #	MBB-FE294/S/PUB/110	p 784	N84-29881	#
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AVRADCOM-TR-82-B-2	p 755	N84-28743	* #	FAA-ARP-84-2	p 794	N84-29889	#	NAS 1.15:83730	p 781	N84-28790	* #
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BMFT-FB-W-84-005	p 766	N84-28773	#	FAA-83-4.1-VOL-1	p 784	N84-29881	#	NAS 1.15:85817	p 756	N84-28747	* #
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BMFT-FB-W-84-011	p 740	N84-28731	#	GAC-19-1615	p 796	N84-28887	* #	NAS 1.15:85825	p 811	N84-30331	#
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COA-8409	p 755	N84-28744	#	H-1242	p 773	N84-29863	* #	NAS 1.15:85947	p 790	N84-28809	#
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DDR-1099	p 808	N84-29234	#	H-1246	p 791	N84-29885	* #	NAS 1.15:85982	p 820	N84-30887	* #
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								NAS 1.26:165631-VOL-1	p 789	N84-28802	* #
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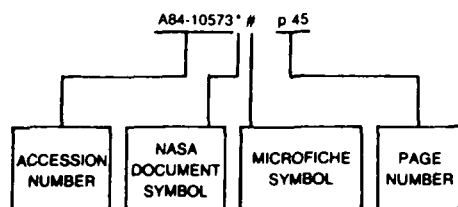
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Denver, CO 80203
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UNIV. OF FLORIDA LIBRARIES

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Documents Department
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Athens, Ga 30602
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UNIV. OF IDAHO LIBRARY

Documents Section
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Indianapolis, IN 46204
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(301) 454-3034

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Boston, MA 02117
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Detroit, MI 48202
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Santa Fe, NM 87501
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UNIVERSITY OF NORTH DAKOTA

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Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.

Documents Department
Stillwater, OK 74078
(405) 624-6546

PORTLAND STATE UNIV. LIB.

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Portland, OR 97207
(503) 229-3673

STATE LIBRARY OF PENN.

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Harrisburg, PA 17105
(717) 787-3752

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(512) 471-2996

TEXAS TECH UNIV. LIBRARY

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Documents Department
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